



Urban transport and community severance: Linking research and policy to link people and places



Paulo Rui Anciaes^{a,*}, Sadie Boniface^b, Ashley Dhanani^c, Jennifer S. Mindell^b, Nora Groce^b

^a Centre for Transport Studies, University College London, Chadwick Building, Gower Street, London WC1E 6BT, UK

^b Department of Epidemiology and Public Health, University College, London, UK

^c The Bartlett School of Architecture, University College, London, UK

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ABSTRACT

Urban transport infrastructure and motorised road traffic contribute to the physical or psychological separation of neighbourhoods, with possible effects on the health and wellbeing of local residents. This issue, known as "community severance", has been approached by researchers from a range of disciplines, which have different ways of constructing scientific knowledge. The objective of this paper is to build bridges between these different approaches and provide a basis for the integration of the issue into public policy. A framework for cross-disciplinary research on community severance is developed, built on the results of two workshops attended by researchers from different disciplines. This framework takes into consideration the chain of direct and indirect effects of transport infrastructure and motorised traffic on local communities and the complexity in the methods used for analysing and formulating solutions to the problem. The framework is then compared with the views of practitioners, based on discussions held in a third and final workshop. It was concluded that to better understand community severance, researchers should frame their work in relation to that of other disciplines and develop tools that reflect the diversity of local contexts and stakeholders, balancing complexity with applicability.

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1. Introduction

The concept of community severance is used when transport infrastructure or motorised traffic acts as a physical or psychological barrier to the movement of pedestrians. The most extreme cases of community severance are caused by multi-lane roads with physical barriers preventing pedestrians from crossing (Fig. 1a). Even in the absence of these barriers, crossing may be difficult due to features of the road design such as median strips (Fig. 1b) or to high motorised traffic volumes or speeds (Fig. 1c). Severance may also occur in narrow roads with low traffic volumes if there is a lack of basic pedestrian infrastructure such as pedestrian pavements (Fig. 1d).

Despite the growing evidence of the potential impacts of this phenomenon on public health (Mindell and Karlsen, 2012; Cohen et al., 2014; Boniface et al., 2015; Mackett and Thoreau, 2015), there is a scarcity of tools to identify and measure the problem, limiting the scope of policy interventions (Anciaes et al., 2016). This may be because community severance has been approached by researchers in different disciplines, including public health, economics, geography, and urban studies. These researchers have used different concepts and methods to define and analyse the problem. The issue is also relevant to a range of stakeholders, including local communities, road users, and practitioners in different fields, including not only transport and health, but also urban planning and local economic and social policy. These stakeholders have different understandings of the problem and its solutions, and possibly even different opinions about whether this is a genuine problem that should be given priority.

The objective of this paper is to establish an approach for cross-disciplinary research on community severance. It is hoped that this approach will facilitate the dialogue between the different disciplines with an interest in the problem and promote the exchange of data and results among researchers and practitioners currently working separately in the development of policy solutions.

* Corresponding author.

E-mail address: p.anciaes@ucl.ac.uk (P.R. Anciaes).

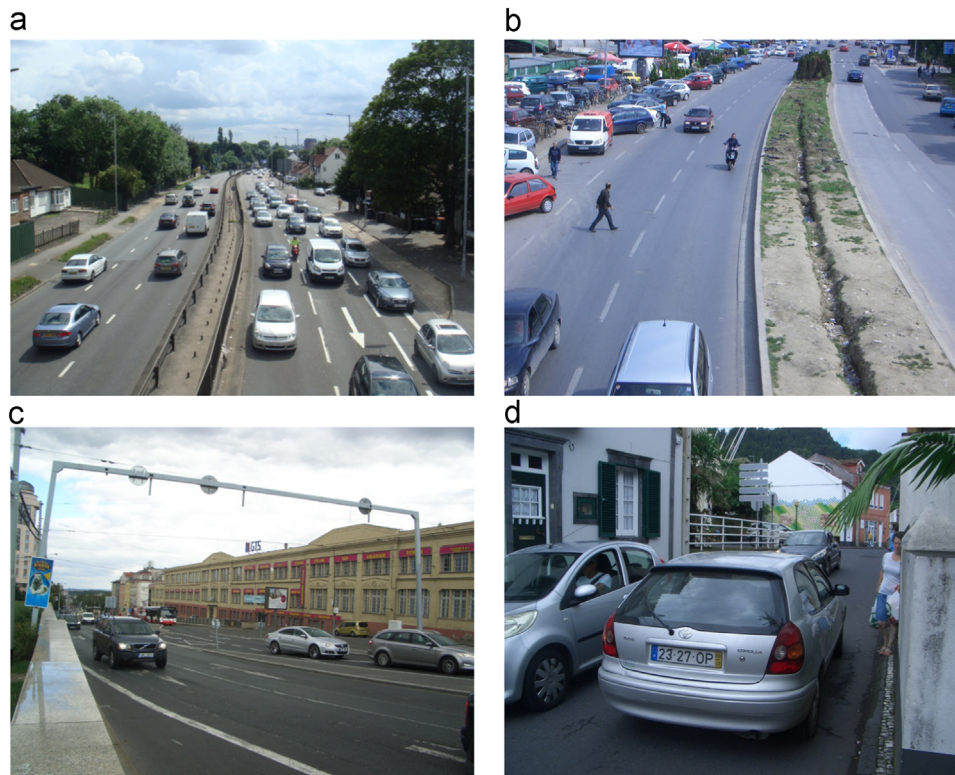


Fig. 1. Examples of severance: a) London, UK; b) Skopje, F.Y.R. of Macedonia; c) Prague, Czech Republic; d) Açores, Portugal.

The paper is the outcome of three workshops organised by the *Street Mobility and Network Accessibility* research project, which is developing tools for identifying and measuring community severance (<http://www.ucl.ac.uk/street-mobility>). The objective of the first two workshops was to compare the multiple understandings of severance used in the different academic disciplines and establish a common language among the members of the project. The third workshop included external advisors and representatives from partner organisations and aimed at discussing opinions and experiences related to actual policies dealing with severance as well as to identify common ground and key points of distinction between the approaches of researchers and practitioners.

The paper is structured as follows: **Section 2** identifies community severance as a problem in the interface between transport, health, and other fields, and as an object of cross-disciplinary research. **Section 3** reviews the issues commonly found in the production of cross-disciplinary research and in its integration into public policy. **Section 4** develops a framework for cross-disciplinary research on community severance. **Section 5** discusses the compatibility of this framework with public policy, taking into account issues raised by stakeholders on the problem. A final section summarizes the findings.

2. Community severance: transport, health, and more

The development of public policy to address community severance has been hampered by the fact that research on this topic has been produced by different disciplines working separately. The differences start with the terms used to define the issue, including variants such as community severance (UK DOT, 1983; Clark et al., 1991), barrier effect (Korner, 1979; Borges et al., 1983), social severance (Lee and Tagg, 1976; Tate, 1997), and community effects (Smith and Gurney, 1992). There is little consensus on the meaning of these terms, as evident in the review of Anciaes (2015), who collected sixty different definitions of community severance and related concepts used in the literature since 1963. Handy (2003) has also noted that severance can be understood either as the converse of connectivity (which is related to the physical characteristics of the local street network) or community cohesion (which takes into account the social implications of those physical characteristics).

Community severance has been regarded as an issue of transport policy because the transport system accounts for the majority of the barriers that separate urban neighbourhoods, including linear infrastructure such as roads and railways, and other large infrastructure such as airports, railway stations, and car parking areas (Héran, 2011). Severance is also a transport issue because it limits the mobility of users of non-motorised means of transport such as walking (Hine, 1996) and cycling (Emond and Handy, 2012). In some countries, the appraisal of major transport projects considers severance impacts (UK DfT, 2014), although these impacts are not usually quantified or valued in monetary terms (Anciaes et al., 2016). A few studies have also called for greater awareness of severance at the level of transport network planning and road design (Rajé, 2004).

There is growing acknowledgement that community severance is also a public health issue. Studies in several countries have shown that high levels of motorised traffic and high traffic speeds discourage walking (Owen et al., 2004) and limit social contacts between residents on opposite sides of the road (Appleyard and Lintell, 1972; Hart and Parkhurst, 2011). There is also growing evidence on the health impacts of insufficient physical activity (Reiner et al., 2013), reduced social networks (Holt-Lunstad et al., 2010), and poor accessibility to goods and services (Mackett and Thoreau, 2015). However, few researchers have been able to disentangle the multiple cause-

effect relationships between all these variables in order to understand the mechanisms through which busy roads ultimately lead to poor health outcomes. According to Mindell and Karlson (2012, p.232), community severance is "a plausible but unproven cause of poor health".

While the studies above suggest that severance is in the interface between transport and health, the issue is also relevant to researchers and practitioners in other fields. The relationships between traffic barriers and social cohesion (Leyden, 2003; Sauter and Huettenmoser, 2008) and spatial segregation (King and Blackmore, 2013; Mitchell and Lee, 2014) are of interest to social scientists such as sociologists and anthropologists. Researchers in the fields of architecture, urban planning, built environment, and space syntax are also interested in community severance, given the evidence that the structure of the street network is linked with health (Marshall et al., 2014) and with social cohesion (Cooper et al., 2014). The need to place severance on an equal footing with other impacts in the appraisal of large projects has also motivated economists to develop methods for estimating its costs in monetary units (Grisolia et al., 2015).

Issues of local mobility have also been entering the agenda of grassroots movements such as neighbourhood and community improvement associations, which have become more empowered by developments on access to open data and mapping technology and online platforms for dissemination of their views (Kingsley et al., 2014). These developments have been facilitated by the growing interest in participatory action research (Balazs and Morello-Frosch, 2013), and frameworks for policy appraisal such as community impact assessment (US DOT, 1996).

Despite the potential for cross-disciplinary research, the only instances where community severance has been analysed from multiple perspectives were large-scale studies such as PhD theses. Of particular note is the work of Hine (1994) who studied traffic barriers using pedestrian video surveys, questionnaires, and in-depth interviews, in order to assess the impacts of motorised traffic on pedestrian attitudes and behaviour. The fact that this work remains the most comprehensive study of the topic two decades after it was conducted suggests that researchers have still not developed a cross-disciplinary approach to community severance. This may be explained in part by problems inherent to the production of cross-disciplinary research and to the application of this type of research in public policy. These aspects are explored in the following section.

3. Cross-disciplinary research and the production of policy-relevant knowledge

Cross-disciplinary research has the potential for analysing complex issues beyond the restrictions of individual disciplines, which are often affected by "generalising, decontextualising and reductionist tendencies" (Horlick-Jones and Sime, 2004, p.442). This type of research is particularly promising for the study of relationships between transport and health. In particular, the assessment of the links between mobility and well-being benefits from cross-disciplinary research because mobility depends not only on the availability of transport but also on environmental, social, and psychological aspects (Vella-Brodrick and Stanley, 2013). Sallis et al. (2006, p.314) also suggested that promoting active travel requires input such as physical activity measurements and behaviour change models (provided by health and behavioural sciences), methods of conceptualising environmental factors (provided by architecture, urban planning, transport research, and leisure studies) and strategies to advocate the adoption of policies (supported by policy studies, political science, and economics).

However, disciplines have contrasting, and sometimes conflicting, ways of producing knowledge, relying on a specific set of assumptions. They are also separated by the different concepts used to describe the same phenomena and by the different meanings assigned to the same word (Bracken and Oughton, 2006; Monteiro and Keating, 2009). The issue of unequal power among disciplines has also been documented. It is often the case that some pairs of disciplines are accustomed to working alongside one another, while other pairs overlap less (Choi and Pak, 2008). Some disciplines like geography are more inclined to cross-disciplinary work, as they themselves contain a diversity of distinct branches (Schoenberger, 2001).

Projects in broad fields such as urban research are especially vulnerable to these issues (Ramadier, 2004; Petts et al., 2008). Methods common in some disciplines, such as economic valuation and cost-benefit analysis, are viewed with suspicion in other disciplines. For example, the use of concepts such as the value of a statistical life and the value of essential environmental goods tend to elicit strong reactions (Norgaard and Bode, 1998). The study of urban mobility is a good example of a field where the inconsistency among different approaches has become a pressing issue. Coogan and Coogan (2004) noted that transport planners tend to study walking using measures such as the number or share of walking trips, in contrast to the physical activity measures (e.g. minutes of moderate physical activity) used by epidemiologists. Cavoli et al. (2015) also reported that practitioners feel there is a lack of data sets linking transport and health.

The literature on the links between research and practice also suggests that there is an entrenched view that policy-makers use research only for general orientation rather than for solving specific problems (Weiss, 1978). This may be due to the ambiguity of the empirical results produced or to the lack of applicability of the solutions developed by researchers (Brownson et al., 2006). In the case of transport, there is also a lack of belief in the usefulness of research for decision-making in areas such as the development of sophisticated transport models (Hatzopoulou and Miller, 2009) and the study of social aspects of transport (Miciukiewicz and Vigar, 2012). Bertolini et al. (2008, p.72) argue that successful and innovative concepts in transport planning can emerge only in the interaction between researchers, practitioners, and other stakeholders. Cross-disciplinary research may have an advantage in this respect, given its focus on specific "real world" problems and the involvement of different actors. This may facilitate network building with stakeholders and the generation of knowledge relevant for action (Walter et al., 2007).

Researchers have tackled these issues by creating opportunities for debating how each field approaches specific problems and for initiating dialogue with stakeholders. For example, Straatemeier and Bertolini (2008) reported the result of workshops attended by researchers and practitioners to develop a framework to integrate land use and transport planning in the Netherlands, highlighting the need to adapt transport policies in order to contribute to broad economic, social, and environmental goals. James and McDonald (2004) and James et al. (2005) engaged with local practitioners in different fields and analysed their perspectives regarding the development of solutions to community severance, identifying common issues faced by those practitioners in their communities, such as the specific mobility needs of vulnerable groups (like the elderly) and the limitations of solutions like footbridges and underpasses. The present paper builds on these efforts, by bringing researchers together to develop a common understanding of community severance and by assessing the compatibility of this understanding with the views of practitioners.

4. A framework for cross-disciplinary research on community severance

The first two workshops were set up to identify the common ground that exists across the disciplines when approaching community severance, and to develop a framework for the research. The workshops were attended by the ten members of the *Street Mobility and Network Accessibility* project. Each participant presented three key issues from their discipline that related to severance. The presentations were followed by discussions. Table 1 list the three topics presented by each of the ten researchers, grouped by discipline.

The table reveals some differences in the key issues presented by researchers from different disciplines. Some disciplines (such as transport geography and planning) focused on spatial and physical aspects, others (such as anthropology) focused on social and psychological aspects, and others (such as space syntax) on the relationships between spatial and social aspects. However, there were also some important differences on the issues presented by researchers from the same discipline. For example, one of the participants from the field of economics focused exclusively on stated preference surveys as a way to derive people's willingness to pay for improvements in severance, while the other participant reflected on the broad objectives of economic science and policy, mentioning normative issues, such as equity, which are not captured by stated preference methods.

It was agreed that the majority of the topics presented answered two broad questions: what is affected by community severance and what are the possible methods to identify and solve the problems presented by severance. In addition, these answers can be further integrated by considering that severance is a chain of effects (Section 4.1) and that the methods to analyse the issue have different degrees of complexity (Section 4.2).

4.1. Community severance as a chain of effects

Community severance can be defined as a continuum stemming from the presence of transport infrastructure or motorised traffic and including a chain of effects at the individual or community level (Fig. 2). The challenge for any research project on severance is to track this chain of effects. Participants agreed that cross-disciplinary research brings added value because, as was obvious after the discussion in the workshops, different disciplines tend to focus on different parts of the chain and so the results of the analysis of one discipline can inform the definition of the research problem of the discipline focusing on the next effect.

The participants agreed that the transmission of knowledge would be facilitated by distinguishing direct effects (those of an independent variable on a dependent variable that do not operate through a mediating variable) from indirect effects (those of an independent variable on a dependent variable that operate through a mediating variable). However, it was also noted that the identification of causality

Table 1
Topics about community severance presented by participants of each discipline.

Disciplines	Topics
<i>Epidemiology and public health</i>	<ul style="list-style-type: none"> • Reduced number of trips, decreasing independence and affecting daily life • Reduced active travel, leading to physical inactivity and its disease consequences • Reduced social contacts (trips to visit family and friends, streets as social spaces) • Collisions • Socio-economic inequalities • Gender inequalities • Healthy ageing • Well-being and quality of life • Resilience
<i>Economics</i>	<ul style="list-style-type: none"> • Efficiency in the use of resources • Equity in distribution of road space to motorised vs. non-motorised modes of transport • Stated or revealed preferences as means to monetise impacts • Methods: Which of the problem attributes are comparable across different contexts? • Methods: How to present those attributes to individuals? • Methods: How to elicit individuals' monetary valuations of severance?
<i>Transport geography and planning</i>	<ul style="list-style-type: none"> • Accessibility: ease of access to goods, services, and activities • Mobility: ease of movement • Travel decisions: trade-off between walking time and pedestrian environment
<i>Built environment and space syntax</i>	<ul style="list-style-type: none"> • Cities are complex systems and work at multiple scales • Spatial configuration shapes movement flows and social encounters • Interruptions and interventions in the urban fabric have a social impact • Local variations in spatial structure • Differing spatial communities and personal geographies • History and the experience of change over time on perception and sensitivity
<i>Anthropology</i>	<ul style="list-style-type: none"> • Patterns of establishing and maintaining social networks over time • Differences in usage patterns based on personal attributes (e.g. age, disability) • Impact on an individual's "sense of place"
<i>Participatory action research</i>	<ul style="list-style-type: none"> • Who: identification of stakeholders • Why: the role of information and action to overcome community severance • How: what methods are appropriate for community engagement and action

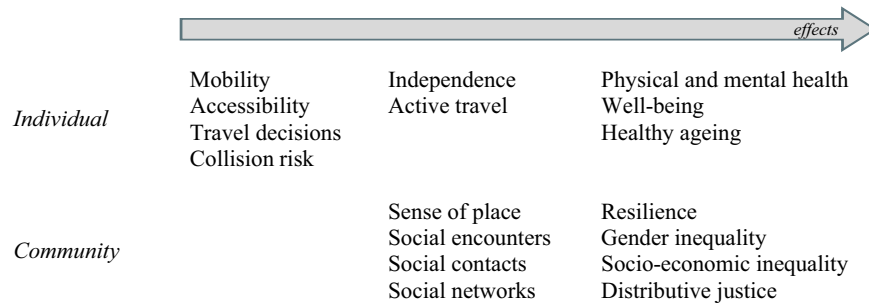


Fig. 2. What is affected by community severance?

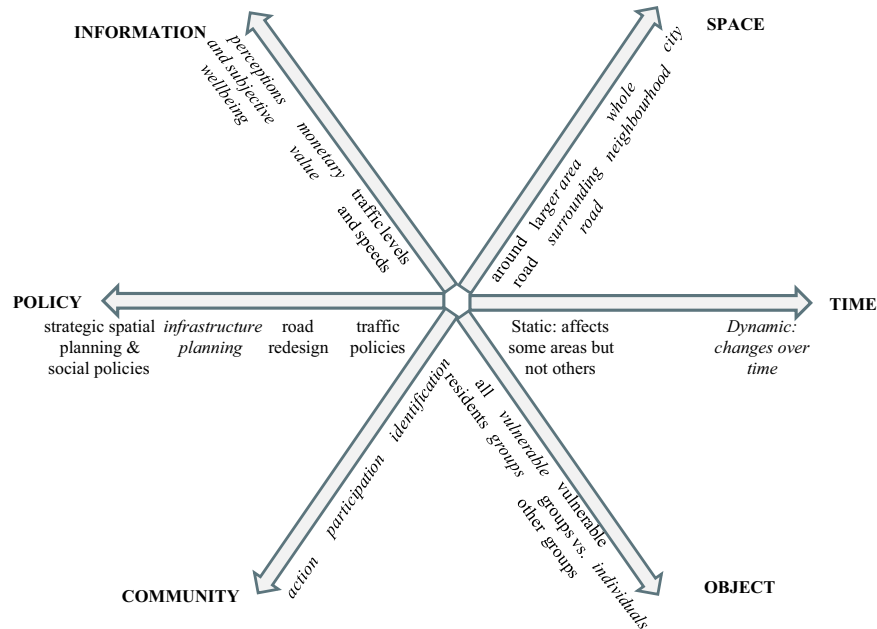


Fig. 3. Complexity in the methods to study community severance.

Note: Items in italic were included in the participants' presentations. The other items were implicit to some of the presentations or were mentioned in the discussion that followed.

may create problems in the dialogue between disciplines. For example, a fundamental aspect of space syntax research is not to attribute any causality between spatial and social changes (Montello, 2007), and epidemiology also emphasises the differences between association and causation (Hill, 1965). The direction of some of the effects presented can also be questioned. For example, severance impairs mobility but impaired mobility also means that the effects of severance are realised. Severance means fewer social contacts but social isolation also means that a road is not used for socialising.

The types of relationships between variables are also important, as we cannot assume linearity in the impacts of severance across multiple aspects of individual and collective well-being. Participants noted that disciplines relying on quantitative methods may be more alert to this aspect, but there is a risk that these disciplines will try to model relationships that are difficult to interpret or translate into actual recommendations for public policy, as mentioned in Section 3.

An important discussion point was the origin of this chain of effects. The term "busy roads" was mentioned in several presentations, but neither the words "road" nor "busy" were mutually agreed upon. Railways also create a barrier to mobility, which may be assessed using different methods from those used to study roads. Broader terms such as "areas where access is difficult" were proposed as alternatives. Just how busy the road must be in order to start the chain of effects, and how to define "busy" were also discussed. This is important because severance is related not only to the physical characteristics of the road (such as traffic volume, speed, and composition) but also to the perceptions of people living near the road. In addition, severance may impact pedestrians not only when they cross roads but also when they walk along them. This is relevant for public health (as the unpleasant environment might discourage people from walking, even if crossing the road is not a problem) and built environment research (which has an interest in the role of active frontages enhancing opportunities for social contact (Remali et al., 2015)).

A final challenge is determining the language that should be used to describe the issue. By using a common language, researchers can avoid the problem that arises when the use of specialised terms diverts attention from the more important issues. For example, the concept of "social determinants of health" is common in public health research, but participants from other disciplines questioned how "determinant" are the factors studied and whether they are really "social". A consensus was found by clarifying that the expression refers to a broad concept of the environment surrounding the individual, encompassing geographic, economic and social factors (Dahlgren and Whitehead, 1991). More importantly, the purpose of the research is to investigate whether severance does play a role in people's health,

regardless of the concepts used to describe that role. This example shows the importance in distinguishing between relevant conceptual mismatches between disciplines and “red herring” issues which are of little consequence for applied research projects.

4.2. Complexity in the methods used

The discussion also produced a framework to identify the relationships between the methods used in different disciplines to analyse and solve community severance. Methods can be classified along six axes, with each axis representing the degree of complexity of that aspect (Fig. 3).

4.2.1. Spatial scale

The first axis represents the complexity of the spatial scales used to analyse the issue. Transport planners supported the idea that it is necessary to study roads with high traffic levels to guarantee the applicability of the developed tools in new contexts. However, workshop participants from health and sociological disciplines noted that the effects of severance can be felt at a greater distance from the main road. The perspective from the experts on the built environment was that severance can similarly encompass wider areas, because severance causes breaks in the connectivity of the street network, thus can reduce accessibility across a wide area, as previous research has shown that the configuration of the street network shapes patterns of pedestrian movement as well as encounters across social or economic groups (Hillier and Vaughan, 2007).

The differences between approaches to the study of mobility and accessibility are clear when we quantify their spatial scales. For example, space syntax research usually analyses walking patterns at a range of scales from 400 m up to 1200 m in order to capture the potential for pedestrian traffic in an area, while also taking into account of a contextual area of up to 2 km radius from the studied site to the surrounding areas (Vaughan et al., 2010). In contrast, participants who had expertise in participatory methods reported that they tend to focus on areas of 1–4 km² which define a neighbourhood or area that people walk around within 20–30 minutes. The need for the different disciplines to be aware of the implications of looking at issues related to urban land use using different scales has also been noted in previous literature (Clifton et al., 2008).

4.2.2. Time scale

The second axis represents complexity in the time scale of the problem. Economics has sought to integrate community severance at the level of planning of individual projects, while geographic research has focused on spatial differences in mobility and accessibility across a region at one point in time (Geurs et al., 2016). The space syntax perspective is broader, considering severance as a gradual process, emerging over time, and influenced both by changes in the street network structure and in the interactions between the layout of different neighbourhoods, resulting in changes in the mobility of people living in different parts of the city (Omer et al., 2015; Geddes and Vaughan, 2014). The time scale in this case is measured in years. As anthropologists on the research team pointed out, aspects such as the length of residency of individuals are particularly relevant as such issues affect the perceptions of both the problem and the neighbourhood. In addition, a road may separate two communities that already define themselves separately for other reasons, such as differences in the characteristics of the population or housing.

Interest in the time dimension of environmental inequalities has increased in the past decade, with several studies investigating whether hazardous facilities were constructed before or after the location of low-income populations or racial minorities in the affected areas (Hipp and Lakon, 2010; Mitchell and Norman, 2012). Similar approaches could be used to study the dynamic aspects of community severance over time.

4.2.3. Object of analysis

The third axis represents the complexity in the object of analysis, that is, who is affected by the problem. The existence of particular groups of concern came up as a common theme in several presentations. Those groups were based on age, gender, socio-economic position, occupation, car ownership, ethnic group, and disability. However, it was pointed out that the effects on one specific group can be assessed only if compared with the effects on other groups.

Groups are also not homogeneous. For example, there are distinctions among people classified as “elderly”. From an anthropological perspective, mobility needs are diverse and experiences are unique, and so the distinction between groups and individuals must also be considered (Shortell and Brown, 2014). Within the same community, views differ regarding what is a barrier, and what is its relevance as a problem. The need to consider individual views is supported by previous studies such as those of Hine and Grieco (2003), who studied the differences between studying “clusters” and “scatters” of social exclusion, and Davis and Jones (1996), who noted that children are major users of their local environments but tend to be excluded from research projects and public consultations because surveys are usually aimed at adults.

Participants in the workshops noted that complexity increases when the object of analysis is the individual, rather than the whole community. The in-depth analysis of problems affecting individuals may collide with the approach of disciplines whose methods rely on the aggregation of preferences over groups. For example the stated preference methods used by economists to find the monetary value of severance yield an average “willingness to pay” to solve the problem. Outliers tend to be removed from the analysis. However, the focus of other disciplines may be precisely the analysis of these outliers.

4.2.4. Information

The fourth axis measures complexity in the type of information that is collected and analysed. Traffic levels and speeds on major roads are available from routine data sources. The measurement of the value that the affected individuals attach to the problem is more complex, because this value depends not only on traffic levels and speeds, but also on a range of demographic and socio-economic characteristics. The design of tools (like stated preference surveys) to estimate this value also needs to be careful in order to choose the most suitable way to present the various attributes of the problem to individuals.

It was also agreed by workshop participants that the absence of data is as relevant as its existence. It is as important to consider trips not made and destinations not visited as it is to collect data on existing travel patterns. To capture these factors, it is necessary to learn

about people's perceptions about mobility within and beyond their community and how they delineate the borders of their community. Qualitative data provide in-depth information useful to understand the complex set of factors shaping those perceptions. Some workshop participants raised doubts regarding the degree to which this type of information may be compatible with quantitative data; however, it was generally agreed that qualitative data can help define the research questions and can be used to validate and explain the conclusions obtained from quantitative analyses.

4.2.5. Policy solutions

The fifth axis represents the complexity of the policy solutions for the problem. Policy-makers can use a range of traffic control measures such as speed limits or traffic restrictions. Solutions such as the redesign of the existing infrastructure are potentially more complex as they may have a wide impact on all modes of transport using that infrastructure and on functions of the infrastructure other than as links for movement for example, as spaces for social interaction. The planning of new infrastructure may be even more complex because it has effects on other domains, such as land use. Policy-makers can also design interventions in these other domains to achieve goals at the city level. Social policies can also be used as a method to mitigate the impact of severance on local communities.

4.2.6. Community engagement

The sixth axis represents the level of community participation in the development of solutions to the problem. Academic research has traditionally used a 'top down' approach, involving the identification of communities living in the case study areas and the collection of data from a sample of individuals. This data is then analysed and disseminated without the involvement of feedback from the community. However, the use of alternative approaches is growing. Participatory action research holds particular promise for providing additional insight as it adopts a bottom-up approach to researching community issues, learning from the participants in the case study areas and allowing emergent ideas and data to inform subsequent research. However, there are different degrees to which communities can actively participate in the analysis of the problem and formulation of solutions, due to cultural and conceptual challenges and issues regarding access and production of data (Haklay, 2012).

5. Bridging the gap between research and policy

The third and final workshop in the series brought together the researchers in the *Street Mobility* project and 20 other participants from local authorities, consultancy companies, national professional bodies, and non-governmental organisations. These participants represented a cross section of the skills and expertise related to community severance at the policy and practitioner level and enabled discussions on the relationships between transport and health based on experience gained in a variety of urban areas in the United Kingdom. The objective was to assess the main differences between the views of practitioners from different fields, such as transport planning and provision, urban planning and design, public health, and economic and social policy.

The members of the project first presented the objectives and methods of the research. The participants were then split into groups to discuss the two broad issues arising from the first two workshops: the causes and effects of severance and the methods to analyse and solve the problem. The following sections identify some common topics raised in those groups, signalling some differences between the approaches of researchers and practitioners. The main points to retain from the discussion are the need to anticipate the multiplicity of users and applications for the tools produced by the research (Section 5.1) and the administrative, political, and financial problems that limit the application of the solutions proposed (Section 5.2).

5.1. Multidisciplinarity or multiple research?

The participants in the workshop highlighted the influence of the local context in the development and application of tools to address severance. For example, tools developed using case studies in urban and suburban locations do not address issues that are unique to rural areas, where the main accessibility issue is the lack of public transport. Ideally, areas where there is severance should also be compared with areas where severance is non-existent or has been overcome. In other words, the development of tools that can be routinely applied in different contexts requires testing in multiple circumstances.

The discussion groups also noted the diversity of practitioners with a possible interest in the tools developed by researchers. Practitioners in different fields tend to be interested in different aspects of a research project and in different types of output (Papadimitriou and Yannis, 2014). These outputs must then be tailored to different user groups' specific requirements, for example, for transport appraisal procedures, health impact assessments, and street design plans. As such, the participants in the workshop discussions emphasised that it is important that the common dialogue established by researchers also makes sense to and satisfies the stakeholders on the problem. In addition, researchers should also facilitate dialogue between different stakeholders.

However, the fact that research outputs need to cater for a diversity of practitioners does not imply the creation of multiple tools. Participants in the workshop mentioned the existence of tools already in use to identify the problems that road traffic can pose to pedestrians, including, for example, pedestrian counts (TFL and Colin Buchanan, 2007), street audits (Allen and Clark, 2007), route assessments (CBT and Abellio, 2013), walking accessibility mapping (Brown and Wood, 2004), and frameworks for community-led initiatives (Sustrans, 2010). Many of these tools have been developed with specific settings in mind (for example, high streets or routes to key pedestrian destinations such as school or train stations), and have neither been widely disseminated nor developed in order to be generalisable to other settings. It was found during the discussion that tools used in some departments of local authorities are unknown even to staff in other departments working on the same issues in the same communities.

It was agreed that any research project on severance should start by reviewing the existing tools and evidence and consider the possibility for the integration of different types of intervention currently made using different tools in different places and sectors, as well as the integration of methods proposed in previous research but never implemented. This approach could be an alternative to the development of a whole set of new tools. However, such tools must be reviewed and assessed from a cross-disciplinary perspective to determine the broader applicability of their findings to the issues raised in the preceding discussion.

For a research project on severance, the considerations above mean that the selection of the relevant cause-effect relationships depicted in Fig. 1 and of particular methods from those represented in the different axes of Fig. 2 must be specific to the context being analysed and to the purpose of the tools produced. There is a risk that the level of detail required to cover all the relevant contexts and to design a coherent suite of tools may lead to loss of focus for the project.

5.2. Complexity vs. applicability

The comments of several participants also suggest that the complexity in the methods used in cross-disciplinary research on severance may in some cases limit the applicability of the outputs produced.

For example, the scale of the problem (the differing severance that may occur for different types of mobility within the city) may be incompatible with the scale of policy interventions. Practitioners have only a limited set of instruments available at each level. Professionals working at the level of town planning can decide on the location of roads and railways. Those working at the level of the neighbourhood or street can solve problems of particular areas, for example by street design solutions such as the removal of subways and guard railings. One of the conclusions from the workshop was that research projects should look into the compatibility between the policy solutions proposed and the instruments available to the institution implementing those solutions. It was further noted, however, that even when this compatibility is assured, the implementation may still clash with the policy priorities and agendas of governments at a higher administrative level.

The success of policy interventions also depends on administrative boundaries, because these boundaries determine where people access services such as health care. The collection of data is complicated when the data is held by institutions in another administrative area. The need to fit the content of instruments such as surveys to administrative boundaries can also pose problems. It was noted by some participants that in public consultations, some respondents gave negative feedback to proposals where administrative boundaries were used to delimit communities.

There was concern that the use of a cross-disciplinary approach may produce tools that are too expensive or require expertise that is not available for local authorities. For example, video surveys and stated preference surveys tend to be expensive, while space syntax methods require the use of special skills and software. The collection of information at different levels of detail and the consideration of different spatial and time scales (Fig. 2) may be unwieldy. The conclusion the workshop participants reached in light of these expressed concerns was that a cross-disciplinary research project on severance should have as one of its key goals the translation of a broad range of concerns into outputs that are manageable to end users.

Research projects on community severance can also develop methods for simplifying the tools in the cases where practitioners do not have access to the technical or financial means to apply them. For example, the time and cost required to quantify motorised traffic levels and pedestrian flows or to conduct street audits can be reduced if the research produces a typology of the different links of the road and pedestrian networks and advises practitioners on methods for collecting data in only a small sample of links of each type. Stated preference surveys could also be used to derive monetary values for severance in different contexts, which can be used by local authorities that do not have the means to implement their own surveys.

6. Conclusions

This paper set out to understand community severance as an issue that is relevant to transport and health and as an object of cross-disciplinary research. A framework for applied research on community severance was proposed, built on the reflections obtained in workshops attended by a cross-disciplinary team of researchers and a group of stakeholders that included local authorities, non-governmental organisations, and consultants. The input from different disciplines was used to break down community severance into a continuum of effects, which can be analysed by methods with different levels of complexity.

We believe this framework can help researchers to locate their own perspective in relation to that of other disciplines, and that it thus helps clarify relevant issues when applying the research to actual problems affecting different stakeholders. Importantly, the discussion with the project stakeholders demonstrated the need to question the breadth of hypotheses, outputs, and audiences for the research, and administrative, political, and financial problems in the application of the solutions proposed.

It is hoped that the reflections produced in this paper can inform research on other urban issues where transport and health are component parts of a broader, multifaceted phenomenon that is of interest to a range of domains of research and practice. The paper shows that the efforts for the coordination of different disciplines involved in a common project must begin with the mapping of objects and methods of analysis of each discipline. The advantages of cross-disciplinary research will only be achieved if the participants understand and communicate around issues related to their specific approaches. The research also needs to be framed in such a way that they can be understood and used within policy contexts.

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