In the Paris metro, hell is other people

Martin Koning and Luke Haywood

In the medical field, it is not unusual for remedies prescribed to combat a particular condition to have undesirable side effects. Similarly, the example of Paris shows us that rising levels of discomfort on public transport can be considered the "price of success" of anti-car policies…

While Parisian transport policy – which primarily hinges upon the reassignment of lanes dedicated to polluting modes of transport (cars, essentially) to cleaner alternatives (buses, trams, bicycles) – has made it possible to reduce motor traffic in the French capital by 24% between 2000 and 2010, millions of people pay the price of this every day. In addition to motorists, whose journeys now take longer, users of the city's metro and RER[1] services also have to put up with more uncomfortable travel conditions as a result of increased passenger numbers: as public-transport provision has not increased at the same rate as demand (+10% and +22% respectively between 2000 and 2010), the density of passengers on trains has substantially increased (+10%) while the frequency of service has remained constant (at least across the metro network). In essence, road congestion in Paris has been fought with road congestion, which in turn has generated another form of congestion, with rail-based public transport increasingly crowded during the daily rush hours.

This article presents a field study undertaken in Paris in late 2010 that sought to place a value on the level of comfort of travel on the Paris metro (Haywood and Koning 2013), where comfort is defined as the amount of space available per passenger inside metro trains. While the study of this externality[2] has been developed over many years in the United Kingdom (Wardman et Whelan 2011), French decision-makers until recently had no empirical material at their disposal in order to evaluate the level of importance that passengers place on travel of comfort in comparison to other factors such as travel time or ticket pricing. Passing on this message has long been left to journalists, who relay passengers' dissatisfaction through articles describing ever more uncomfortable travel conditions or underlining the need for investment in increasing capacity.[3] Psychologists and sociologists have also studied crowding in carriages by studying associated sources of discomfort (Mahudin 2012), by examining the way in which emotions enable passengers to deal with this discomfort (Aranguren and Tonnelat 2013), or by considering how the situation could be improved by making changes to working times (Munch 2014). Any objective consideration of transport policy, however, requires first having a precise idea of the benefits that improving levels of comfort in the Paris metro would bring.

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1. The RER (*Réseau express régional* – Regional Express Network) is a network of five rail lines that cross Paris and connect with pre-existing suburban rail lines which previously terminated at the city's principal mainline stations. Within the city of Paris proper, RER lines essentially run underground and act as express metro lines (trains run faster and stops are farther apart); in the suburbs, these lines generally offer a higher-frequency (if sometimes slower) service than Transilien suburban rail services (which terminate at mainline stations and do not cross Paris).
2. The term "externality" is used when an individual action modifies the well-being of a number of citizens without this being taken into account by the "market(s)". In this case, the public authorities have to implement corrective action (taxation or standards) in order either to limit the damage caused by negative externalities or to promote and encourage positive externalities.

Studying trade-offs between time and comfort

The usual approach to assessing the level of comfort of a given journey is to ask individuals to choose between two travel options: the first is shorter but more uncomfortable; the second longer but more comfortable. Unlike studies in environmental economics, respondents are not offered the option of paying a monetary contribution in order to benefit from any contingent scenario (better air quality, cleaner beaches, etc.); here, time is the adjustment variable. This course of action has real benefits. For instance, economists often challenge the credibility of "declared preferences", as these often correspond to intentions rather than acts.[4] Proposing time-based options therefore reduces the various biases inherent in this kind of exercise: passengers may lie when offered the possibility of paying more for their journey in exchange for less crowded metro trains, in the hope that others would pay the increased fare in their place (while they jump the gates and travel "clandestinely"). Furthermore, this type of time-based scenario is particularly realistic, as it is not uncommon to see passengers wait for the second or third train if the first is too crowded, or indeed to change their travel plans if they judge that their initial choice of route is too congested. Such cases are perfect examples of individuals sacrificing time in exchange for greater comfort. In view of this kind of trade-off, it is therefore reasonable to assume that passengers' responses are credible.

Our study of the value accorded to comfort in the Paris metro (Haywood and Koning 2013) focused on lines 1 and 4, two of the busiest lines on the metro network, which cross Paris from east to west and north to south respectively. Between November 2010 and January 2011, almost 800 passengers were interviewed during the morning and evening rush hours (7.30–10.00 a.m. and 5.00–7.30 p.m.), directly on the platforms of 11 stations. The questionnaire was intentionally short, so that passengers could reply while waiting for their train. Those who did not mind waiting for the second train could also respond to a second survey containing questions on more qualitative aspects.[5] In order to measure the level of comfort experienced by passengers, as well as travel times, these interviews were complemented by passenger counts and timing observations, carried out directly in metro trains, in January and February 2011.

Like British studies on this subject, a visual aid representing seven different passenger density levels in carriages was shown to respondents (Figure 1), who would indicate the level of comfort they anticipated experiencing once they got on the train after the interview. On average, respondents imagined that they would be faced with a density of three passengers per square metre (Scenario 5 in Figure 1). This evaluation was correlated with the objective comfort level (obtained via in-train passenger counts), as well as with respondents' income level (positive correlation), with whether the line in question was line 1 (positive correlation), and with whether the interview took place in the evening (positive correlation). From this "reference point", respondents were asked whether they would accept a journey time that was a (randomly chosen) number of minutes longer in exchange for an (also randomly chosen) improvement in comfort level.

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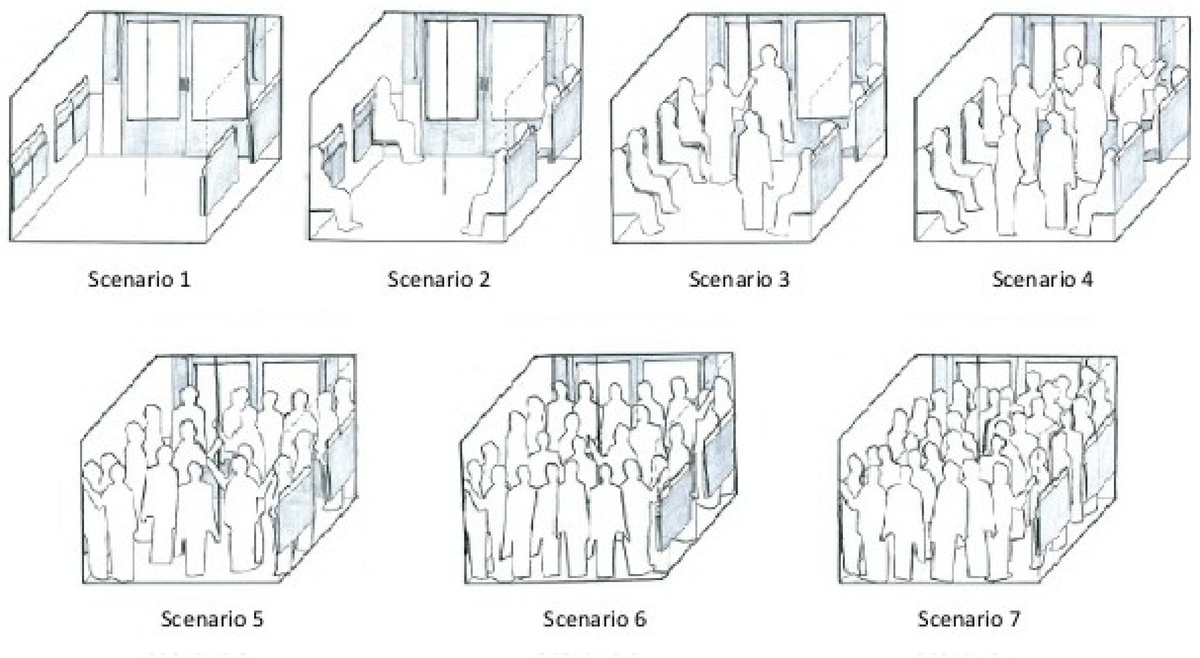
3. See in particular the blog "L'interconnexion n'est plus assurée" (named in reference to the announcement heard on the RER network when one of the two companies – RATP and SNCF – that jointly run the two busiest lines experiences operational difficulties leading to delays/cancellations on certain branches), on the website of *Le Monde* (in French): http://transports.blog.lemonde.fr.
4. In order to highlight externalities, economists generally prefer to study "revealed preferences" via individuals' behaviour (e.g. purchasing a mask to protect against air pollution).
5. The number of respondents for the first (quantitative) questionnaire (see below) was 688, over 30% of whom also chose to answer the second questionnaire.

Figure 1. Visual aid used during the survey



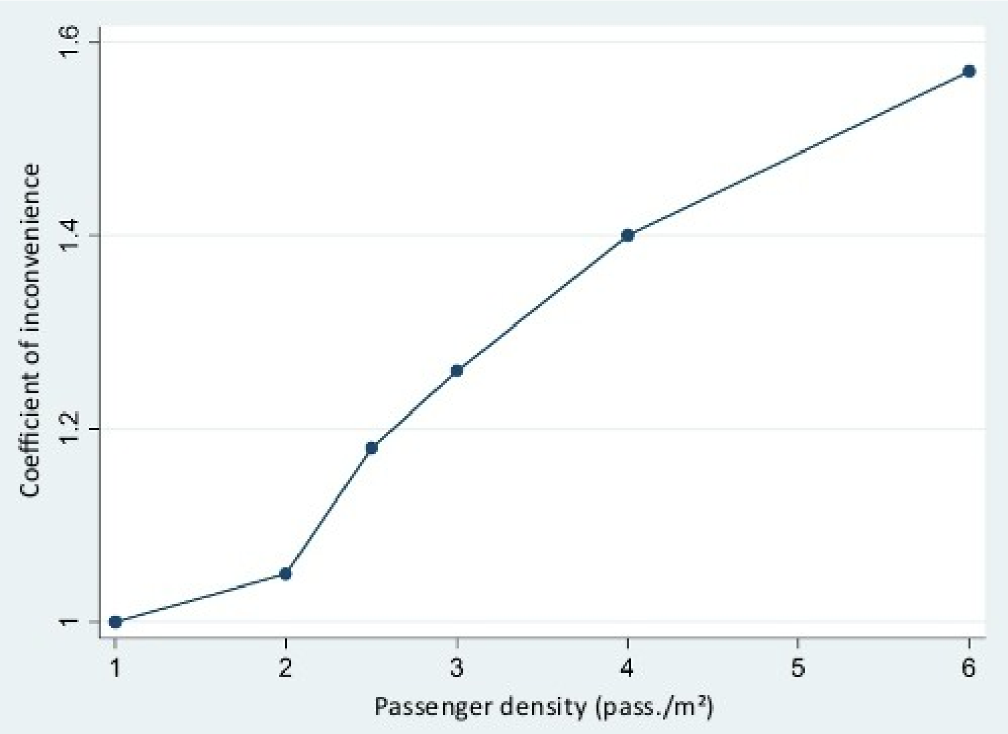
Uncomfortable journeys make long travel times even more unbearable

The trade-off proposed to respondents was, on average, a 60% reduction in passenger density in their carriage in exchange for a journey that took 9 minutes longer, which corresponds to the average amount of time spent travelling on lines 1 and 4. Almost 42% of respondents accepted these hypothetical scenarios, thus illustrating the importance that passengers attach to a more comfortable journey,[6] with higher positive response rates for interviews conducted on line 1 (49%) and in the evening (45%).

These responses enabled us to assess the level of discomfort generated by an additional minute of travel time, for each of the seven passenger density levels shown in Figure 1. As expected, this "marginal" minute is especially penalising for users when it is spent in uncomfortable situations. Our estimates also show that, for a given level of comfort, those passengers interviewed during the morning rush hour more often refused to trade time for greater comfort, probably owing to constraints linked to their time of arrival at their final destination (typically the workplace).

[6] It can therefore be shown that individuals were, on average, prepared to make a journey that took 3.8 minutes (= 0.42 × 9) longer in order to benefit from the hypothetical increase in comfort.

Figure 2. Relationship between the coefficient of inconvenience and passenger density



These results can be used to establish a "trade-off rate" between uncomfortable and comfortable travel time. To do this, we must first choose a reference comfort level (Scenario 2 in Figure 1, with a density of approximately 1 passenger per square metre) and use this as a benchmark for comparing levels of time-related inconvenience with levels of inconvenience for other travel conditions. As Figure 2 shows, the trade-off rate (or "coefficient of inconvenience") increases with the level of discomfort. In the most extreme situations, passengers would be prepared to accept 1.6 minutes of journey time travelling in comfort (seated, at a density of 1 passenger per square metre) in order to avoid 1 minute of travelling in highly uncomfortable conditions (6 passengers per square metre).

If we consider the average comfort level, as perceived by passengers at peak times (3 passengers per square metre), the coefficient of inconvenience stands at 1.34. If travel time were to be quantified in monetary terms, the time spent in more uncomfortable metro trains could therefore be said to be more costly (by 34% on average). Using a value of €12 per hour (corresponding more or less to the median hourly wage in France), the cost of greater comfort therefore amounts to an extra €4 per hour. Consequently, a 15-minute metro journey in the rush hour would "cost" a passenger almost €4, once the monetary value of this time and various subsidies were taken into consideration – and, of this sum, €1 is due to passenger overcrowding in metro carriages.

Changing the way transport policies are evaluated

We can now illustrate the advantages associated with an accurate assessment of travel comfort in analysing transport policies. One tool traditionally used by economists to estimate the social return on investment is the cost–benefit analysis. As its name suggests, this consists of comparing, in monetary terms, the advantages and disadvantages of a given course of action.

The automation of line 1, operational since December 2012, can be used as a case study (Haywood and Koning 2013). The investments made (totalling some €630 million) have resulted in increases in the speed and frequency of metro trains, consequently leading to an increase in comfort for passengers, all other things being equal. While the reduction in waiting time on the platform during the rush hours corresponds to a gain of €6.5 million per year for users, the increase in speed and comfort (inside the metro trains) at these times of day is equivalent to an annual gain of €71 million, 40% of which is attributable to a lower passenger densities in the carriages. If we add to this the time gains for passengers travelling off-peak (equivalent to €39 million) and compare all these benefits to the initial investment, it becomes clear that the policy of converting metro lines to driverless operation is more than justified.[7]

Although current transport policy goes against this kind of measure, it would be possible to imagine a fare system for the Paris metro that sought to force passengers to "internalise" the marginal cost of the congestion they impose on other users, rather like the congestion pricing measures implemented in London and Stockholm for road traffic. On the basis of economic efficiency alone, this would mean that transport fares in Paris would have to be practically doubled (Haywood *et al.* 2013)… But ultimately, what credence can be given to these calculations? While the kinds of suggested fare increases we mention here should, of course, be tempered according to social considerations, it is interesting to note that the assessments of the value of comfort presented here for the Paris metro network were recently confirmed by a study commissioned by STIF (Syndicat des Transports d'Île-de-France), the transport organisation authority for the Paris region (Kroes *et al.* 2013). Despite some differences in the survey protocols used, this study also reveals a certain consistency in passengers' preferences with regard to comfort. It is therefore to be hoped that the public decision-makers take action and (rapidly) implement policies that are more in touch with the daily experiences of millions of users.

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[7] Some would argue that more comfortable journeys on metro line 1 attract passengers from other lines (RER line A in particular), leading to a deterioration in travel conditions on line 1. In this case, however, the gains in comfort for the users that switch to line 1 should also be taken into consideration, the final effect in all likelihood being no overall charge in terms of the almost linear relationship between the coefficient of inconvenience and passenger density (see Figure 2).

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