Stretching hyperpaths: How ubiquitous real time information can affect transit system use

Achille Fonzone, Edinburgh Napier University
Jan-Dirk Schmöcker, Kyoto University
Valentina Trozzi, Imperial College London

Convincing people to get off their cars and to travel in more sustainable ways is a major goal for transport policy. Public transport is a valuable alternative for urban and metropolitan trips but it is still largely underutilised in many, if not most, cities. Undoubtedly, to be really competitive, public transport needs to close the gap with private means in terms of spatial and temporal ubiquity of service supply. Existing financial constraints – which are sometimes getting even tighter – limit the amount of runs which can be offered by operators. However, in complex networks there is the possibility of fostering a modal shift without augmenting the provision of transit services. This can be done by using ITS to make users more aware of the available options. In this paper we show the potential of information supply in changing the perceived service supply and so inducing a higher and more efficient use of existing services.

Different from private transport systems, public transport services are discrete in time and in space. As a consequence, normally passengers have to wait at stops. Unless the traveller has perfect knowledge of the timetable and the service is punctual the waiting time and therefore the overall travel time (i.e. including waiting, on-board time and possibly transfer time) is random and can be reduced by adopting strategies made up of both pre-planned and en-route decisions. For instance a slower – in terms of on-board travel time – service may let the traveller arrive at the destination earlier than a faster one if it turns up before, and the difference between the on-board times of the two services is smaller than the estimation of the extra time the traveller should spend waiting for the faster service.

Route choice depends on the adopted alighting/boarding strategy and on estimation of waiting time. Both are influenced by available information. In the seminal Spiess and Florian's approach (1989) the departure and arrival stops, and the set of *attractive lines* are predetermined whereas the set of actually used services depends on which line in the attractive set shows up first at the first and at each intermediate stop. The definition of the attractive set relies completely on (simplified) a-priori distributions of probability of headways and so of waiting times. Clearly the incorporation of information – even just observation of elapsed time (Billi, 2004) – can lead to more precise estimation of travel times and more complex strategies.

Using simulation and a small scale example Hickman and Wilson (1995) and Gentile et al. (2005) discuss that the reduction of the average travel time (and of its variability) due to the availability of real time information on departure times is minor even for information with high accuracy level. However they find the information may affect route choice significantly. Considering that the availability of information may make different stops/platforms attractive Nökel and Wekeck (2009) confirm the impact of information on route choice and demonstrate that it can generate remarkable reduction of mean journey time.

Ubiquitous availability of real time information can influence boarding/transferring/alighting in two ways which we define in this paper as *hyperpath extension* and *hyperpath widening*: Firstly it can extend the adoption of the adaptive behaviour from the real origin to the real destination of the trip

rather than from the boarding to the alighting stop as it is when only frequencies are known (hyperpath extension). Consider the beginning of the trip. Without real time information the traveller will access the transit network always from the stop with the shortest expected travel time among those he can reach with different means. But, analogously to what happens with the line with the shortest expected overall travel time in absence of real time information, the stop might not be optimal given the actual situation of the services. The optimal departure stop choice becomes possible if knowledge on the current network *status quo* becomes available by ubiquitous real time information. Similar considerations can lead to a "dynamic" choice of the best alighting point. Furthermore, at large stations with multiple and separated platforms, real time information also enable choosing the platform on the basis of the expected residual travel time given the current network conditions rather than on the basis of the minimum expected residual travel time without knowing the actual situation. This allows considering services running from different platforms in the set of attractive lines (hyperpath widening).

Extending the Nökel and Wekeck (2009)'s formulation of different information levels a modelling framework is provided to take account of ubiquitous information in route choice and travel time estimation. The paper exemplifies both "hyperpath extension" and "hyperpath widening" and discusses the conditions for their occurrence. Their effect on expected travel times, and the distribution of passenger flows among different services is illustrated. From here conclusions are drawn on the potential effectiveness of information provision in modifying perceived service supply and with it transit use.

Key references

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