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Interactions between rail and road safety in Great Britain

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ABSTRACT

This paper discusses the results of an investigation into ways in which the safety risks of travel on road and rail interact with each other in Great Britain, other than through physical contact such as at level crossings. The two main foci of the paper are: (1) an analysis of the 'whole journey' risks of journeys for which the national rail system is the main mode, but which also include stages by other transport modes to provide access to the railway system; and (2) an analysis of the effect on safety risk of inter-modal transfers between rail and road. On (1), walking to and from stations was estimated to account on average for 65% of the overall door-to-door risk of being killed on rail journeys; the rail system itself accounts for 21% of the risk, and other access modes account for the remaining 14%. The average distance walked to and from stations is 0.9 km per rail journey, and this walking accounts for 5% of all walking nationally. On (2), it was found that increasing rail fares to fund railway safety measures may lead passengers to switch from rail to car, but for most sensible rail safety measures, the additional risks from such diversions are small compared with the intended rail safety benefits. However, for high-cost rail safety measures funded by passengers, the additional risks from diversions may be of the same order as the intended safety benefits. The last section of the paper explores the effects of variations in the casualty rates of rail users as pedestrians and car users, because their road risks may be different from those of all road users. Such variations could alter the detailed conclusions of the paper, but the scale of such effects appears to be modest.

1. Introduction

Safety is one of the five primary objectives of integrated transport policy in Britain[2], but safety policies themselves are generally developed separately for each mode. In practice both achieved levels of safety and safety expenditure relative to risks are higher for the public transport modes than they are for the roads. This leads to questions about whether safety resources are used to best effect.

Although they are separately managed, there are some strong interactions between rail and road safety. The most obvious of these interactions are at the physical interfaces between the rail and road systems: these include collisions at level crossings and bridges. Level crossings now contribute the greatest potential for catastrophic risk on the railway and they accounted for 36% of all railway fatalities in the four years to 2003/2004. However, this paper focuses on interactions other than the physical interfaces, though the physical interfaces are implicitly included in the risk estimates presented. The two foci of the present paper are

(1) an analysis of the 'whole journey' risks of journeys for which the national rail system is the main mode, but which also include stages by other transport modes to provide access to the railway system; and
(2) an analysis of the effect on safety risk of inter-modal transfers between rail and road.

The reason for concentrating on these is that they are important but less investigated than the physical interfaces, which are the subject of other research projects. The previous literature on the interaction between road and rail risks as discussed in this paper is limited. Jorgensen (1993) is an interesting paper with similarities to the present one that considers risks on commuting journeys in Copenhagen when undertaken by different modes. Evans et al. (1990) compared the safety of driving and flying in the United States: we refer to their paper below.

The principal results presented here are for Great Britain as a whole, though some results on rail travel patterns are separately presented for journeys wholly in London, journeys with one end

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[1] Tel.: +44 20 7679 1572.
[2] The other four primary objectives are environment, economy, accessibility and integration.

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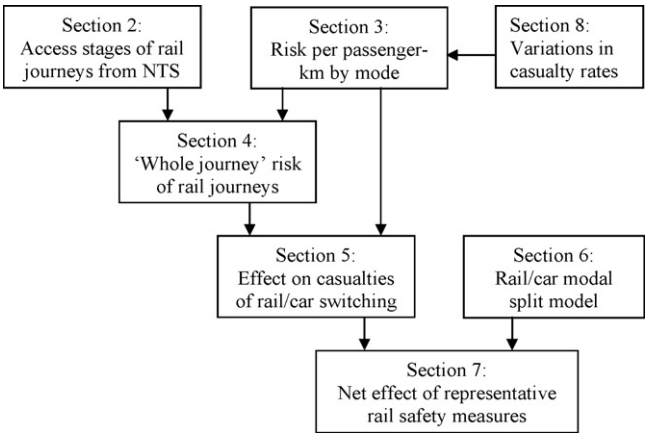

Fig. 1. Structure of paper.

in London, and journeys with neither end in London. The primary data sources are:

(1) the British National Travel Survey (NTS) for 1999–2001 for data on the patterns of national rail use, on modes by which national rail travellers reach railway stations, and for the development of a rail/car modal shift model; and
(2) data on the risks of death and injury per passenger-km for national rail travel, for car travel, and for all access modes. These data cover casualties both to the travellers themselves and to others affected, such as pedestrians in the case of motorised road travel, and level crossing users in the case of rail travel. These data are based on various periods of up to five years ending in 2003.

Fig. 1 shows the structure of the paper following this introduction. Section 2 presents data analysed from the NTS on the access stages of journeys for which main-line rail (labelled 'surface rail' in the NTS) is the main mode. Section 3 presents estimates of casualty risks by mode, both for travellers themselves and for other people affected. Section 4 combines the results of Sections 2 and 3 to give 'whole journey' risks for journeys with rail as main mode. Section 5 estimates the effects on casualties of the switching of journeys between rail and car, using the modal risks from Section 3 and the 'whole journey' risks of rail journeys from Section 4. Section 6 presents a modal split model estimating in particular the response of travellers to increases in rail fares. Section 7 combines this model with the results of Section 5 to estimate the net effects on safety of two representative rail safety measures funded by passenger fare increases, taking account of the effect of such increases in inducing diversions from rail to car. Finally, it is possible that the risks for the rail using population when walking or driving differ from those of the population as a whole. Section 8 considers reasons for this, and explores the effect of different risks on the results.

Table 1
Average number of stages per journey for journeys with different main modes.

Main mode	Average number of stages per journey
Walk	1.0
Car	1.0
Taxi	1.0
Other private	1.1
Local bus	1.7
London Underground	2.6
Surface rail	2.9

Source: Department for Transport (2002), Table 3.9

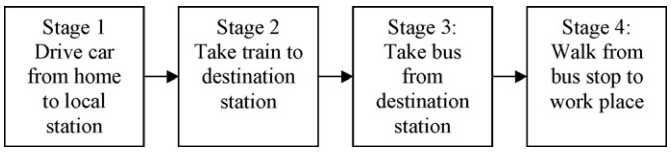

Fig. 2. Illustration of stages in a journey.

2. Journeys for which surface rail is the main mode

The National Travel Survey collects information about all journeys made by respondents in a period of seven consecutive days beginning on a random day of the week. The NTS defines a (one-way) journey as set of 1 or more stages by different modes, illustrated by the 4-stage journey to work in Fig. 2 that includes one stage each by car, rail, bus and walking. The NTS defines the 'main mode' of a journey as the mode with the longest stage, measured by distance. The NTS defines 'surface rail' as the main line or 'national' or ex-British Rail network, and these terms are used interchangeably. Surface rail does not include the London Underground or other metros, which are treated as different modes.

As well as recording journey stages by mechanical transport modes, the NTS includes walk stages of more than 50 yards. However, short walks are frequent, and in order to reduce the burden on respondents, walk stages with lengths in the range 50 yards to 1 mile are recorded on only one of the seven days (the last). Therefore walk stages of less than 1 mile need separate treatment in the analysis from other stages, and multiplication by 7 before being recombined with the other data. This has been carried out in the results below, and no further distinction is made in the walk stages of different lengths. In practice there is some evidence that walk stages of 1 mile or more, which should be recorded in full on all days of the survey, are somewhat under-recorded, but in the present work no adjustments are made for that.

Table 1 – extracted from the published report on the 1999–2001 NTS (Department for Transport, 2002) – shows the average number of stages per journey for journeys with each of the principal main modes. The main mode is itself one of the stages, so a main mode with an average of exactly 1 stage per journey would have no subsidiary stages. In fact the averages in Table 1 have been rounded in the publication to one place of decimals, so that some modes recorded as having 1.0 stages per journey may in fact have a few subsidiary stages. In particular, as mentioned below, about 3% of car journeys have an associated walk stage. The main finding from Table 1 is that public transport journeys have many more subsidiary stages than personal transport journeys, and that surface rail journeys have more subsidiary stages than any other mode[3], though London Underground journeys are not far short.

There were 5749 journeys in the NTS for 1999–2001 for which surface rail was the main mode. Most of these involved a single surface rail stage, but the journeys also included 74 second or third surface rail stages, which are described in the tables below as 'secondary rail'. In addition, there were 202 surface rail stages on journeys for which another mode was the main mode (such as rail stages to airports for domestic air journeys); these other journeys are disregarded in the analysis. Of the 5749 journeys, 1791 (31%)

[3] The published average of 2.9 stages per surface rail journey in Table 1 is slightly different from the 2.8 calculated in our own analysis of the NTS data in Table 2 (below). The reason for this difference is unclear, but it is not large enough to be of concern.