Australasian Transport Research Forum 2013 Proceedings
2 – 4 October 2013, Brisban Australia
Publication website: http://www.patrec.org/artf.aspx

# Route finding as a consequence of a reduction in road capacity

Rosemary Sharples

University of Technology, Sydney

Email for correspondence: rosemary.a.sharples@student.uts.edu.au

## Abstract

The conditions for using a car in Brisbane, as elsewhere, have changed over the years. However, one of the same drivers as before is still there: that is, motorists' desire to make trips by driving in the way that is comfortable for them. The driver that is traffic congestion is also still widespread.

This paper considers the driver of travel and transport that is habits. In particular, it considers the habits (including use of technology) which affect the choice of route when there is a reduction in road capacity. In this situation there may be initial confusion about what motorists should do and where they should go, in order to carry out their usual trips.

The normal expectation of route choice is that a path between an origin and a destination will be selected (in advance) so as to minimize the distance and/or time required. A desire to avoid paying tolls is also an expected reaction. Less often discussed are the decisions that motorists make while driving about which roads to use as a result of their own perceptions of the traffic situation.

This paper discusses a qualitative study of motorists affected by the reduction in road capacity that occurred on Epping Road after the Lane Cove Tunnel in Sydney was opened. It found a range of different bases for choice of route, depending on the motorists' attitudes, knowledge and existing habits. This can be used to explain why any chaos that occurs when a road is narrowed, is short-lived.

**Key words:** travel behaviour; route choice; reduction in road capacity; habit; qualitative study

# 1. Introduction

The conditions for using a car in Brisbane, as elsewhere, have changed over the years, with an increase in the number of cars on the roads, an expanding urban area, road tunnels, toll roads and new drivers for transport, such as the need to enhance the sustainability of travel. The possibilities for using electronic communications to avoid the need for trips have expanded from telephone and fax to include options such as videoconferencing, teleworking and social media. However, one of the same drivers as before is still present: that is, motorists' desire to make trips by driving in the way that is comfortable for them.

This paper considers the driver of travel and transport that is habits; in particular, the habits which affect the choice of route. It is based upon the results of a qualitative study into the effect of reduced road capacity (RRC) on motorists. It concerns the particular case of route choice where the network design has changed such that capacity is reduced and drivers are faced with an unfamiliar road layout. In such instances, there may be initial confusion about what motorists should do and where they should go in order to carry out their usual trips.

It is sometimes assumed that reducing road capacity in this way will cause chaos, but the empirical evidence, from case studies of RRC in 55 locations around the world, is that traffic disappears, to the extent that it needs to (Cairns, Hass-Klau & Goodwin 1998, p.57) and that any chaos is short-lived (ibid, p. 6). Although there has been work done on route choice under conditions of uncertain expectations of delay (e.g. Sikka 2012) there has been limited study conducted on the problems of uncertainty in network layout. This paper builds on work done by the author and elsewhere, to suggest a possible reason for any chaos being short-lived.

Transport planners are interested in motorists' choice of route because of their desire to ensure efficient use of the road network. Route choice may contribute to congestion if the demand for a route is greater than the capacity of that route or an incident on the road blocks the free flow of traffic. There is also interest in how advanced traveller information systems (ATIS) such as variable message signs (VMS) affect travellers' decisions. Choosing routes through the network (traffic assignment) is the final element of the four stage gravity model of transportation and therefore route choice is an integral part of transport modelling. Knowledge of the way routes are chosen is also important for travel demand management, traffic control, design of road infrastructure and the development of electronic technology for trip planning.

The rest of this paper is divided as follows: Sections 2 and 3 briefly review the concepts of habit and route choice as they relate to this paper; Section 4 provides background information on the study on which this paper is based and highlights some results; Section 5 discusses the findings of the field work and with the aid of two hypotheses, suggests reasons for any chaos being short-lived. Section 6 draws conclusions from the work described.

# 2. Habits

'Habit' is a word that is loosely defined in general speech. It is usually used to mean behaviour repeated without thought, whether that behaviour is repeated merely because it is the most reasonable (or only practicable) action under the circumstances, or whether it is repeated because it has become an automatic choice. A more precise definition, which emphasizes the automaticity of habits and the manner in which habitual behaviour is cued by the environment, is that proposed by Verplanken & Aarts (1999):

> *Habits are learned sequences of acts that have become automatic responses to specific cues, and are functional in obtaining certain goals or end-states. …*

It has been observed that both intention and habit can control behaviour (Triandis 1977). In the case of strong habits, there is little seeking out of new information. Where habits are weak, behaviour is controlled by intention (for which information seeking may be necessary) (Gardner 2009).

Habits are important because they speed up the performance of actions, while ensuring that they are not forgotten. However, their automatic nature may create a problem when the conditions that created them initially no longer apply and the habit is no longer the optimal course of action. It may be difficult to alter the habits to produce more appropriate behaviour.

> *A choice that is non-deliberate may in fact be difficult to influence with rational arguments (e.g. increased costs), since the person making the choice tends to discount relevant information. (Gärling & Axhausen 2003)*

Habits in the area of transport can range from such matters as the use of seatbelts (e.g. Wittenbraker, Gibbs & Kahle 1983; Mittal 1988) through choice of mode (e.g. Verplanken & Aarts 1999; Gardner 2009; Kerr, Lennon & Watson 2010) to route choice (e.g. Polydoropoulou, Ben-Akiva & Kaysi 1994; Papinski, Scott & Doherty 2009). The latter is the subject of interest here.

Polydoropoulou, Ben-Akiva & Kaysi (1994) found that about 50% of the motorists they surveyed felt that habits were important in the choice of route. Papinski, Scott & Doherty (2009) found that two of their 31 survey subjects did not plan routes as their route choice was habitual. In Australia, a survey commissioned by the National Transport Commission found that "habit was one of the main reasons for current transport behaviour, particularly among drivers" (Hoye, Andreadakis & Vercoe 2011, p. 21)

# 3. Route choice

## 3.1 Introduction

Transport planners are interested in motorists' route choices for a variety of reasons, as described in Section 1. Some authors seek to explain how motorists determine the route they follow in terms of factors such time, distance, delay and costs of travel (Outram & Thompson 1977; Antonisse, Daly & Ben-Akiva 1989; Polydoropoulou, Ben-Akiva & Kaysi 1994; Sikka 2012).

In more recent years, researchers have been particularly interested in the role that the provision of information (in particular ATIS, such as VMS), plays in determining route choices (e.g. Abdel-aty et al 1993; Polydoropoulou, Ben-Akiva & Kaysi 1994; Dia 2002; Furusawa, Woolley & Yue 2004). Models have been developed to explain this process (Ben-Akiva, de Palma & Kaysi 1991) and how the choice of route can be used to manage traffic and enhance the performance of the network by encouraging drivers to divert from congested links.

Satellite navigation systems have been used in recent years to obtain a more accurate picture of drivers' route choices than is available from diaries or by means of stated preference techniques (Li, Guensler & Ogle 2005; Papinski, Scott & Doherty 2009).

## 3.2 Method chosen in order to develop a route

Although travel time, cost, distance and so on are clearly vital elements in the route choice process, they are not the first actions related to route choice to be considered in trip making. Before these factors come into play, and after the decision has been made that a trip is to be made, a decision will be made (or a habit invoked) that determines the framework to be used to determine the route – that is, travellers must decide whether they will use their own judgement or that of a third party. This may help explain how the traveller behaves during the trip.

A route may be known before the traveller sets out (planned or as a result of past experience) or develop as the trip progresses.

A route known in advance may be:

- specified by a third party;
- already known to the traveller;
- planned by the traveller using the sources of information available;
- computer generated from a database of route information.

Routes specified by a third party include bus routes, routes that company drivers are required to follow and itineraries. A traveller who knows the area through which the route passes may already have a good knowledge of alternate routes because of experience gained through trial and error. If the traveller does not know the area, they may want to plan their trip. There are many sources of information, including:

- other people with greater relevant experience;
- personal knowledge;
- maps (both printed and electronic);
- broadcast traffic reports (radio, television);
- on-board navigation units;
- Internet trip planners and telephone information services;
- itineraries.

Broadcast information may warn of areas to avoid.

A route may develop as the trip progresses:

- a known route may be disrupted by incidents experienced (or information received) en-route; or
- a diversion may be required from a known route to bypass anticipated delays on the basis of information received (e.g. ATIS or traveller observations);
- it may be generated in response to the presence of landmarks, signs or compass directions;
- it may be generated by random turnings or following other motorists.

As the trip proceeds, there may be disruptions (e.g. the motorist (or a passenger) may recall an errand which must be completed in the course of the trip; or the motorist may take a wrong turning). Alternatively, the motorist may see or hear something which suggests that there will be a disruption to their trip (e.g. congestion) if they continue on the route they are currently using.

Sources of information that may result in the route being altered include:

- personal knowledge including visual inspection;
- broadcast traffic reports (radio, television);
- variable message signs;
- electronic guidance systems;

Any of the information sources mentioned may then guide the motorist as to how to modify their route.

Polydoropoulou, Ben-Akiva & Kaysi (1994), in a survey of 898 motorists covering 3218 morning commute trips, found that two-thirds of the trips made presented opportunities for route-switching. However, in only 6% of those 67% of trips did motorists actually switch routes. Of that 6% of trips where the motorist switched routes, only 8% received additional traffic information (from the radio) before switching even though en-route information was received in 24% of all trips. Thus, the survey found that route-switching occurred in only a very small percentage of trips and even fewer drivers switched because of the information they had received. In fact, 62% of motorists who switched did so because of what they saw.

Dia (2002) also found that changing route was not a very frequent event. The responses to his survey of peak period drivers found that, over a month (i.e. over 40 trips) 25% did not change route at all and the remaining drivers changed route during between one (~10%) and six (11%) trips. The modal value, at ~17% of trips, was two.

Papinski, Scott & Doherty (2009) examined 21 home-to-work trips made over a two day period and found that 20% of drivers diverted from their planned routes. Abdel-aty et al (1993) found that only about 15% of 944 survey respondents in California sometimes changed their route to work.

In no case is there a large section of the flow switching routes.

Once it has been decided whose judgement for devising a route will be used, factors such as minimizing delay or distance can be used to guide subsequent actions, by, for example, selecting the most appropriate of several known routes.

## 3.3 Changes in travel behaviour due to reduced road capacity

### *3.3.1 ESRC report*

The effect of reductions in road capacity was first examined closely in a study that was undertaken by the Transport Studies Unit of the U.K. Economic and Social Research Council (ESRC). The report of the study was entitled *Traffic Impact of Highway Capacity Reductions: Assessment of the Evidence*[1] (the ESRC report) (Cairns, Hass-Klau & Goodwin 1998).

In the ESRC report, it was noted that responses to road closures varied with the passage of time. They will also, of course, vary with the nature of the road closures and whether other changes have also been implemented (e.g. alterations in speed limits or signal timings, or turns banned). The evidence from the case studies did not allow systematic longitudinal examination of motorists' responses to RRC. However, it was possible to infer behaviour (ibid. p. 33) (see also Meyer 1988).

[1] Under the English legal system, the word 'highway' refers to a road or other way (e.g. footpath) over which the public may pass and repass as of right (Martin 1994). In this study, only the carriageway element of highways was considered.

In the very short term (first few days), there is sometimes noticeable disruption (the 'traffic chaos' that is sometimes forecast) which resolves itself. However, this does not always occur, even on the first day. It is suggested that this is because motorists have heeded any advance publicity and altered their behaviour as necessary. This change in behaviour includes changing route or time of travel or mode. Less frequently, there are other changes, such as changing the person who performs the errand. Hendrickson et al (1982) suggest the process of changing behaviour may begin even before the closure. In some cases, commuters reported that conditions were the same or better after RRC (Ye, Mokhtarian & Circella 2010). In the case of the emergency bridge closure on Brisbane's Riverside Expressway in October 2006, twice as many motorists who had taken part in a TravelSmart programme not long before the closure were found to have changed mode as were actually affected by the closure (Marinelli & Watson 2009).

In the short term (up to a year), there is a settling down period in which motorists take account of the new situation. This may be affected by the other events going on in their lives (e.g. moving jobs or home).

In the longer term (over a year), reductions in flow may be eroded or enhanced. Motorists may start reappearing on the network. These may be the same motorists who initially disappeared, returning; new motorists joining; or general traffic growth due to increased car ownership. Economic conditions which affect the amount of travel that is undertaken may also affect flows. However, the ESRC report (op. cit.) contains reports of an initial reduction in flow becoming larger with time, sometimes because of additional policies which reinforce the reduction**.**

### *3.3.2 The 'ripple' effect*

In addition, Hunt, Brownlee & Stefan (2002) found a ripple effect when the Centre Street Bridge, one of six road bridges over the Bow River in Calgary, Canada, was closed to general traffic in August 1999 in order to undertake rehabilitation to extend its life. The works lasted for 14 months. Although some motorists changed modes or discontinued the errand that took them across the Centre Street Bridge, surveys indicated that most of the motorists who would have used that bridge moved to other bridges for their journey. In turn, some of the motorists who were originally using these other bridges also moved to a different bridge, thus creating a 'ripple' centred on the Centre Street Bridge.

## 3.4 Unsatisfactory situations and coping strategies

As they gain experience driving, motorists will also develop coping strategies for dealing with driving situations with which they are not happy. Personal strategies will in part be determined by the motorist's attitude towards driving and the road environment in which they find themselves (Mokhtarian & Raney1997; Raney, Mokhtarian & Salomon 2000; Cao & Mokhtarian 2005; Zapata 2012). At one extreme, motorists who are not in a hurry and who have sufficient reserves of patience may be able to deal with congestion by, for example, 'switching off' or at least using the time during which the traffic is not moving to do other things (e.g. listening to music, putting on their makeup or shaving). At the other extreme, motorists who feel strongly about delay may become impatient and prefer to keep switching routes in order to keep moving. If these unwelcome driving situations keep occurring, these strategies may become habitual.

By introducing motorists to other modes, programmes such as Travel Smart raise awareness, and increase the range, of coping strategies. When these coping strategies are no longer sufficient, motorists may feel it necessary to make explicit plans to manage the situation.

# 4. RRC, route choice and habit – Australian research

To determine the effect of habit on motorists' route choice, the results of a study from Lane Cove in Sydney were examined.

## 4.1 Method

The research upon which this paper is based involved undertaking a qualitative survey of ten motorists affected by the reduction in capacity of Epping Road in Lane Cove which occurred after the Lane Cove Tunnel was opened. The aim was to discover in what ways they had been affected. Discussions with interviewees included choice of route, destination and mode. Other effects were also mentioned, although choice of route is the only one discussed here. In this paper, interviewees are identified by the abbreviations IN1 to IN10.

The ten discussions were supplemented by casual conversations, 18 e-mails and two telephone calls received as a result of publicity about the study in the local papers and the University of Technology, Sydney (UTS) website. Information from one relevant web site and four relevant social forums was also considered. In this paper, e-mail correspondents are identified by the abbreviations EM1 to EM18.

All interviewees were motorists at the time of the reduction in road capacity, although some of them used other modes at times, including bus, train and bicycle.

## 4.2 Lane Cove and Epping Road background

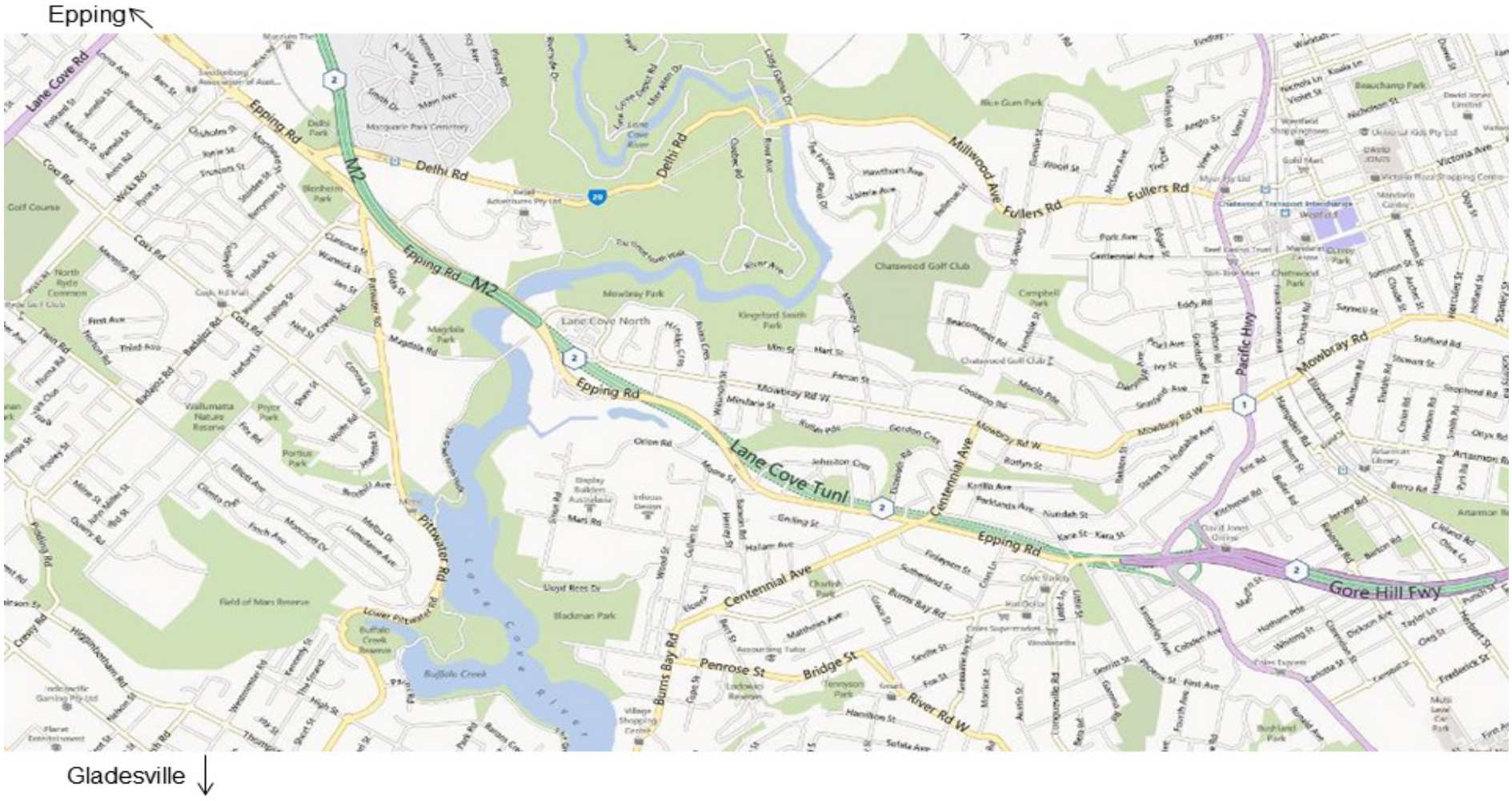
The last link in Sydney's Orbital Motorway was completed in March 2007 when the 3.6 km Lane Cove Tunnel opened. The tunnel linked the M2 and the Gore Hill Freeway and provided an alternative to, and relief for, Epping Road in Lane Cove, to which it runs parallel.

As part of the Lane Cove Tunnel scheme, Epping Road through Lane Cove was reduced from five through lanes between Tantallon Road and the Pacific Highway, (worked on a tidal flow system) and three lanes in each direction further west, for general traffic, to one (or two, when extra capacity was deemed necessary) in each direction. Bus lanes were installed along its length in both directions. In addition, a shared use path for cyclists and pedestrians was provided on the southern side of Epping Road in Lane Cove, which connects to other shared use pathways at either end.

The capacity of Epping Road in Lane Cove was not reduced as soon as the tunnel was opened; rather, the existing road layout was retained and use of the tunnel was free for the first month. As a result, the capacity of the Epping Road corridor was briefly enhanced. Capacity was reduced when a lane in each direction on Epping Road in Lane Cove was closed in order to construct the bus lanes in August 2007. Until the bus lanes were opened in March 2008, buses had to share the remaining road space with all other vehicles. Space was also taken to build the shared use path. Epping Road in Lane Cove acquired its present layout in July 2008. Thus, there was a five month period during which motorists using the Epping Road corridor had the benefit of extra capacity from the Lane Cove Tunnel, before the capacity of Epping Road was reduced. However, it took a year from the opening of the Lane Cove Tunnel before the buses were removed from the main traffic flow.

Epping Road continues westwards from Lane Cove over the Lane Cove River through Ryde and into Epping. These western sections contain bus lanes and transit lanes.

**Figure 1 Epping Road runs between Epping in the north-west and the Gore Hill Freeway in the south-east**




*Source: Bing Maps*

## 4.3 Results

### *4.3.1 Introduction*

As has been the experience elsewhere, there was disruption for motorists after the closure of lanes on Epping Road in Lane Cove, albeit short-lived:

> *Once … the bus lanes … all changed, that was, … a day or two, maybe, but that was much, much better... the first couple of days, people didn't know what was happening … (IN5)*

At this point the Lane Cove Tunnel had been open for five months. Some of the traffic that had previously used Epping Road had disappeared:

> *when the tunnel opened, … there was a drop in traffic on Epping Road. (IN5)*

Some motorists would have transferred from Epping Road to the Lane Cove Tunnel:

> *The tunnel works well if you need to go to the city. (EM1)*

> *…if ever I'm going this way I use the tunnel if ever I can. (IN5)*

There was some resistance to using the tunnel, principally because people felt they were being forced into it:

> *…regarding the narrowing of the Epping Highway (sic). I certainly maintain a rage over this and refuse to use the tunnel myself preferring to go the long way around. (EM13)*

> *… the idea was to make people use … the Lane Cove Tunnel … (IN2)*

Interviewees felt that the narrowing of Epping Road in Lane Cove affected Epping Road further west:

> *All these events, particularly from … the opening of Lane Cove Tunnel, actually affected my travel pattern because the fallback effect starts from Epping itself… (IN10)*

Nevertheless, not every day is the same as every other day:

> *so you have good days and bad days, there may be some days when it's not as, … bad as the other days… (IN10)*

Motorists had to adjust their driving to cope with the new situation.

In the course of describing the way they had been affected by the reduction of road capacity on Epping Road, interviewees mentioned five methods of determining a route for a given trip, either as used by themselves or perceived to be used by other motorists:

1) using the road authority's recommended route between two points;
2) selecting from a palette of routes between two points based on pre-trip information;
3) switching route at junctions or at the site of disruptive incidents;
4) random use of the network;
5) accepting a route determined by means of electronic aids.

### *4.3.2 Principal route*

A principal route, as recommended by the road authority, fulfils some criteria for the traveller travelling between two points. It may offer ease of use, speed or directness. It may also be the only route of which the traveller is aware. In this study, Epping Road was the principal route:

> *… I think most people that know the alternative, would have known the alternative prior to the change… and anyone that doesn't know that there's another way is not probably ready to experiment, especially if they're from another part of town. Like, so if they're on their route to a corporate park and that's the only route they know,… then they're just going to sit in traffic and add to the problem. (IN4)*

Another interviewee chose to use Epping Road on a motorbike because the bus lanes made his journey quicker:

> *… No, no, it's just quicker, … once I went to my motorcycle I found that I could take advantage of the bus and the transit lanes.* ***…*** *that sped up my trip a bit. (IN6)*

It was observed that many people are prepared to tolerate congestion and find a use for the delays:

> *And it's interesting for the differences in, … what people will endure, because … I almost go crazy. I just sit there and … I seriously feel like stopping the car and jumping out and walking, … cause I get so annoyed by it, … and other people, they seem to be putting on their makeup and they're doing things and they're just treating the whole thing like it's their own personal downtime … (IN4)*

### *4.3.3 Selection from a palette of routes*

Some people have a set of alternate routes between their origin and destination. They can choose the most appropriate one for the conditions:

> *And if I was to go there,… and on the day it was … peak time and there was traffic,… you can actually go up, I think it's Mowbray Road, this one … there's a back entrance to the place. I have been there a couple of times during the… work day but I would not go in the morning unless I really had to. Like, had traffic have been backed up, that's the … path I would have taken. (IN6)*

Motorists decide at different stages whether they're going to try a different route:

> *[interviewee's husband] starts off by using Epping Road anyway because … that's the easiest and the quickest way to travel …He has tried going from inside, … Ryde itself, … but then… what happens is sometimes the internal roads, because they're all 50 and school zones etc … it's slower to negotiate that internal traffic … rather than go on Epping Road … it's not a … very good situation anyway, you know … He'll decide on the day. It's the same with me. I … decide on the day, at the time, whether I take off Epping Road,… to Lane Cove Road or I just go straight to Delhi Road…. And sometimes … I decide, OK, today I'll take Delhi Road, … (IN10)*

> *Because I try different routes to come back home … to try and save time … but what I've realized is that each route has its own problems… (IN10)*

### *4.3.4 Route switching*

For the section of the flow which consisted of motorists who are prepared to use an alternative route at some stage of their journey (and who therefore are likely to have a good knowledge of the surrounding area) the presence of congestion or an incident such as a road traffic accident is a signal to take note of their surroundings and actively seek out an alternative route:

> *… when I get to the stop that's Longueville, I can see down there; I can see … the flow; **…** and if it's backed all the way up I know to go straight on and then do one of the back routes, and go up the one way street and all that kind of stuff. … and carry on at the top. If I can see clear, I know I can get a run down … So, I don't … everyday do that, … it's a mish-mash of both, depending on the traffic flow.(IN7)*
>
> *The timing in the mornings, … is also very important and I come along Gore Hill you can, … see on a bike if it's not moving or it's flowing quite freely. (IN7)*
>
> *…doesn't like sitting in traffic, preferring constant movement… finds back streets …being on the move is more important than the actual time it takes. (IN8)*

### *4.3.5 Random use of network*

Desperation could result in them trying any route to bypass congestion:

> *… I got to a point where … every morning I was trying a different short cut to see if I could get around the block … cause I know the roads really well, … like, it's being a country girl, I go by myself, sense of direction, I'll, I'll look for the direction, look where the sun is and go "OK, head this way, head that way and do this" or just start following cars that look like they're going fast and look like they know what they're doing … then finding that they are actually going somewhere relevant. Yeah. Just getting a sense for that. I always do things like that. (IN4)*
>
> *No, I just wait and see what the traffic's doing. … even if I get out to … the first street that I have to turn left into and I see anything I'll turn right…. I'm really flexible, right. (IN4)*

### *4.3.6 Electronic aids*

Electronic aids mentioned by interviewees included:

- broadcast traffic reports (radio, television);
- variable message signs;
- GPS (global positioning satellite) units.

Smart phones, although not mentioned, can also provide traffic information. Interviewees discussed only well known trips, for which they knew (alternate) routes. However, if there were alternatives, the electronic aids were sometimes used to decide which route to take when the trip started (TV) or whether a diversion was in order (radio):

> *I have a television in my room here … when it gets to time the news is on, etc, it comes on,… there's a traffic report every 15 minutes on this particular channel*

> *… it tells you, you know, we're hovering over so-and-so. Forget it, you ain't going to make it home for two hours, etc. (IN3)*

> *Yes, I can use River Road. Sometimes I go through Artarmon, yeah. ... Sometimes. When there accidents and stuff like that and they warn me on the radio then I go through Gladesville. (IN3)*

The commuter cyclist also used a radio on his bike, to get information on traffic:

> *I listen to the radio on the bike, so I get all the news and… I can see them all sitting in their cars. (IN7)*

None of the interviewees mentioned using electronic devices to provide them with an entire route, although the CARR website does suggest using an on-board navigation system to plot a trip to avoid toll roads (Zapata 2012). Nor was everyone impressed with GPS:

> *I won't use it - it's crap. It doesn't work right. (IN4)*

# 5. Discussion

## 5.1 Introduction

From the comments of the interviewees, it can be seen that route-switching (whether on a junction by junction basis or a day by day basis), is normal behaviour for some motorists and therefore part of their coping mechanism when driving. It fulfils all the other requirements for the definition of habit given by Verplanken & Aarts (1999):

- because of the knowledge of alternate routes, it is behaviour that is likely to have been practised;
- it is cued by the sight of significant amounts of traffic;
- the goal is to avoid the congested traffic; and
- interviewees' comments suggest that for some motorists, it is an automatic reaction to congestion.

The consequence of these route switching habits is that each time motorists with these habits drive between a particular origin and a particular destination, their route may vary.

Hence, it is not surprising that this habit was invoked after Epping Road was narrowed, when motorists experienced congestion that they perceived was due to the reduction in number of lanes on Epping Road.

## 5.2 Route switching hypothesis

Bearing these results in mind, as well as the results of other researchers (see Sections 2 and 3), it may therefore be hypothesized that there is a continuum of route-switching behaviour amongst motorists, which varies from none, through occasional, to switching routes whenever the situation exceeds a personal threshold of difficulty. This does not necessarily imply that the motorists have a good local knowledge of the area. They may instead have sufficient self-confidence to be sure that they can find an adequate route (perhaps by following other people or navigating by landmarks or compass directions).

At one extreme, some motorists will disappear from the road if they perceive a problem. At the other extreme, some motorists will not change (this may be because they don't know any alternative; it may be because they prefer to leave experimentation to other people or that

they feel other people should change rather than them ("wait a while and it will sort itself out", "somebody else's problem")). Some will move if they are given explicit instructions about where to go.

In between are people with differing propensities for experimentation. Some may be prepared to try something different after one experience of the new situation (e.g. different route, travel at a different time of day). Those who wait before attempting any changes may also have different thresholds for change. They may change after two days, or a week. There are motorists who will change slowly (e.g. who will keep using a route until they're convinced that things are never going to get better) through to motorists who will change frequently (i.e. at every junction if necessary).

Some people have many alternate routes. and use them already to take action on their own initiative and actively get out of problem situations. For them, RRC is just another cause of congestion.

## 5.3 Minimal-chaos hypothesis

If it is assumed that all motorists lie somewhere along this continuum of propensity to change route, it is possible to offer an explanation of why traffic chaos either does not happen, or if it does, does not last long, in a case of a (real) reduction in road capacity involving the narrowing of roads.

It has been observed that a seemingly steady flow of traffic is in fact changing all the time. Surveys "…have suggested that no more than half the vehicles present on a given day will be present at the same point on the following day." (Bonsall et al 1984). Therefore, it seems reasonable to assume that some of the traffic that might normally use the narrowed route will not be there when the road changes. The new layout is not immediately relevant to these motorists. They can wait and observe the changes. When the flow has settled down, they can re-enter the traffic.

Alternatively, if the motorists have chosen to avoid the route to be narrowed because of publicity (e.g. Marinelli & Watson 2009; Ye, Mokhtarian & Circella 2010), these absentees may be, for example, taking a completely different route, using a different mode, reassigning the errand to someone else or travelling at a different time. They have a low threshold for route change; that is, a high propensity to change.

However, not everyone who is going to be affected by a reduction in road capacity will realize it at the time. Some people will not realize what it means for them. Some motorists (possibly from outside the area) may not be aware of the impending road narrowing. Some people are not able to avoid the route along which capacity has been reduced because they have origins or destinations there. Therefore, a certain element of the traffic will not leave the area of reduced capacity.

Some of the motorists who do use the road with reduced capacity will have a route switching habit of greater or lesser strength. These people form a minority of the traffic. However, given the other absences, this minority, with a tendency to leave a route which is uncomfortable for them, may be sufficient to prevent the long term confusion so often predicted, but not experienced, in these situations (Cairns, Hass-Klau & Goodwin 1998).

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Although narrowed roads are not the same as missing infrastructure, it seems reasonable to assume that a similar ripple effect will occur, if there are alternative routes which drivers may use. That is, the process which occurred on the road where capacity was reduced, will be repeated in places which experience the overflow.

Interviewee comments suggest that the disruption that was experienced after lanes were withdrawn from use was because motorists were unsure about the actions they should be taking at any particular point.

Motorists may be unsure of what to do and where to go (in spite of road authority information), because the conditions to which they have become accustomed no longer hold (e.g. the network layout has changed). Their usual behaviour has been disrupted. Because the network layout has been changed, their routes, in particular, will have been affected.

The minimal-chaos hypothesis states that route switching by a percentage of motorists, in combination with other motorists leaving the route or changing their time of travel, results in changes which tend towards the minimum necessary required to avoid on-going disruption.

## 6. Conclusion

Brisbane has declared itself to be a new world city, but it, and similar cities, contain all the same drivers as before. These are drivers not only in the sense of motorists but also in the sense of forces that bring about the situation in which the motorists find themselves. These include external forces such as the (expanding) road network which services an expanding urban area but which also provides a limited set of practical routes for a trip; the rules for use of the road; congestion (that is, enough other motorists wanting to use the same roads to create problems for everybody) and the mentality that expects people to have the flexibility that the car offers, and the car to be ubiquitous while at the same time authorities are telling people to drive less. The drivers also include internal forces such as an individual motorist's habits, desires and senses of obligation.

This paper has concentrated on one driver: that is, the habits that come into play when a motorist is creating a route, both before the trip commences or while it is underway. The paper discussed five different methods of designing a route, using data from a qualitative study of an Australian incident of reduced road capacity. Many other aspects of driving have the potential to be habitual including the choice of destination, style of driving and choice of vehicle.

As a qualitative study, that is, one designed to ask *why?* questions, this study aimed only to elucidate some of the aspects of the reduction in road capacity that concerned motorists and some of the habits that motorists used in their day to day travel. Further study is necessary to determine the relative significance of these factors in the day to day route choice of Australian motorists.

It may be seen from the literature quoted that habit plays an important part in motorists' driving. It may also be seen that changing route is a normal, albeit not necessarily widespread, part of the process of making a trip.

Two hypotheses have been proposed, in order to explain the empirical observation that any chaos is short-lived (if it happens at all) when road capacity is reduced. The first is that all motorists lie on continuum of tendency to switch routes; the second is that route switchers fine tune the changes that result from reducing capacity, so that no more changes are made than necessary to avoid on-going disruption.

Further research is required to verify these hypotheses. If they can be verified, it will be necessary to determine whether these hypotheses are only valid in the case of narrowing roads or whether they (or modified versions) can be applied to changes on a wider scale, such as those that result from events such as earthquakes which cause long term damage.

## Acknowledgements

Thanks to A/P Hadi Khabbaz, John Huff and Phil Willis for comments on the text. Thanks to John Huff for the map.

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