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Paper title: **Why don't more people catch the bus?**
Is 'one bird in the hand worth more than two in the bush'? (Nathaniel Woods, The Conflict of Conscience IV)

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Abstract (200 words):
Attracting people from their cars to more sustainable means of transport is an underlying objective for many at this conference. However we know that people still cling to their cars and are reluctant to try buses. How easy is it to catch a bus? How does legibility of the bus network affect travel behaviour decisions? Are commuters able to realise the actual potential of the system?

This paper identifies the decision process involved in catching a bus and investigates the actual behaviour of commuters in Auckland. Auckland has a complex system with no consistent network and is composed of an amalgam of operators with different brands, liveries, route brands and ticketing. Commuters' travel behaviour in this environment provides important clues about designing networks that are legible and easy to use.

This work is supported by the Auckland Regional Council and it will assist with network planning.

Introduction

Auckland is no different to many other cities around the world in its desire to attract people from 'single occupancy cars' to public transport.

Consider this:

> Jack is waiting for a bus home at the bus stop. He hasn't come to this stop before and only catches the bus at odd times, but his car is at the panel beater and he thought he would give it a go. A bus arrives but it is yellow and red, and the one he knows is purple. So he waits, but he notices that this bus has the same destination as where he is going but is unsure what route it actually takes. Three more buses arrive, they are different colours, one has Company 1 name but it has green 'Moro' advertising on it, and he knows his bus is purple. He also notices as the bus pulls away that the number corresponds to his normal route. So he asks a fellow traveller what bus he should catch and they suggest that any bus with the route numbers 027, 028, 025, 31 or 37 will get him to his destination. Very soon after that a nearly empty number 31 arrives, he boards and presents his ticket however the bus driver says they don't accept that ticket – he is an ABB bus and that is a Company 1 ticket. Jack despondently gets off and waits another 30 minutes for his purple bus. It has taken more than an hour for him to catch a bus and the next day he collects his car from the panel beater and tells his friends about the nightmare he had trying to get home last night.

Fact or fiction? This snapshot paints a picture of common experiences in Auckland for the bus traveller who is unfamiliar with the system. Auckland has a series of corridors that carry many buses, and bus commuters have a variety of choices while they travel within these corridors. However there is anecdotal evidence that commuters who are used to a certain route brand, operator livery or who carry an operator ticket will not catch alternative buses that go to their destination. Evidence from a particular route brand on a corridor indicates that if unbranded buses are substituted on this route patronage falls by 10%. These observations suggest a need to explore bus commuters' choices since it appears that commuters are not realizing the potential of the system. Bus operators face situations where buses are overloaded, people are left at stops while others are empty because commuters do not understand the variety of choices available.

What are the causes of this confusion? A potential cause of commuter confusion in the Auckland region is the visually and physically fragmented bus network. Visual fragmentation is reflected in different brands and liveries of the nine bus operators as well as a variety of route brands and all over bus advertising. Public transport information is not standardized in content or format, commuters are confronted with various route destinations bus signs and route numbering. Physical fragmentation derives from the lack of integrated ticketing between operators, different timetables, different fare structures, and the variety of bus stop identifiers, infrastructure and information.

This study investigates how legible commuters find this network. It describes the decision choices commuters make and how commuters behave in this environment when catching buses. Based on the results the study aims to develop some principles to assist in increasing legibility and making it easier to use so the full potential of the system can be achieved.

Conceptual background in decision making

Why do we need to understand commuter decision making? To design a public transport network that is legible and easy to use, managers need to understand which attributes of the service are used to make a purchase decision process by which commuters. Without this knowledge, the purchase process is obscured; impairing managers' ability to design a service that effectively provides the information and cues required to make sense of the system and to make effective travel choices. An understanding of the criteria consumers apply in deciding between alternatives is not only an important step for designing a public transport system that is easy to use but it will also yield vital information to bus operators to assist with capacity utilisation.

Typically, what are people's decisions based on? Decision theory encompasses at least two major models (Mowen 1987). These theories show that people's decisions are based on attitudes, belief systems, perceived product attributes, personal timeliness and energy levels. In the case of a high involvement decision (involvement refers to how much time, thought and other resources people devote to the purchase process),consumers form attitudes about various alternatives based on beliefs about the product. However in low involvement decisions (purchasing and repetitive choice behaviours; Hoyer 1984) consumers may make decisions and choices based on the desire to save time, energy and money, and so Einhorn and Hogarth (1981) contend that they are more interested in making an adequate choice rather than an optimal one.

What is a decision choice for public transport commuters? To be defined as a choice decision theorists contend that there are three necessary criteria: (1) two or more alternatives or choices must exist; (2) choices must create a choice dilemma (i.e., a problem situation or uncertainty exists), (Sholten 2002) and (3) cognitive processes must be activated in order to reduce the dilemma (Hansen 1972). In the context of this study, commuters on main bus corridors in Auckland have a *variety of alternatives* available for travel within that corridor. The alternatives consist of a variety of bus route numbers and bus operators with different liveries, brands and bus signage. *Choice dilemmas* arise when several alternative buses arrive at a stop that may have different destinations, numbers and liveries. The bus commuter choice is compounded because commuters may not have all of the alternatives presented concurrently. More typically the options will arrive sequentially. The commuter must decide whether to catch the bus or buses presented, or reject them and wait for a more suitable option. The *sequential nature* of the choice makes this decision more complex and risky than many repetitive consumer product choices, where alternatives can be considered together. Such a sequential decision process is commonly referred to as the secretary problem (Freeman 1983) and it was first described by Chow, Moriguti, Robbins, and Samuels, (1964). They described the problem of hiring a secretary from a known number of applicants. The executive interviews the applicants one at a time. After each interview, an irrevocable decision must be made to hire or reject the applicant under consideration. At any stage, the executive only knows how an applicant ranks with respect to preceding applicants. Bus commuters find themselves in a similar situation, accepting or rejecting buses arriving sequentially. Instead of catching the first available bus going past the destination, the commuter may choose to wait for a known branded bus, or an exact route number. When the known branded bus arrives, it might be late, or worse it might be full and the commuter is left behind at the stop. Because of this uncertainty and the potential for future disappointment**,** it is known that people prefer that uncertainty is resolved all at one time rather than sequentially (Gul 1991; Palacios-Huerta 1999).

Hansen (1972) suggested that *evaluation of alternatives and choice* depend on the expectation that a certain level of utility will result. Alternatively, Burdus (1973) believes that an object that comes closest to being the ideal type and quantity of desired attributes is chosen. A third model was put forward by Tversky and Kahneman (1981) who suggested that consumers *choose on the basis of available options*, the potential outcomes and the probability they will occur. It is hypothesized that in a risky situation such as the bus example, commuters employ the third model (Tversky and Kahneman 1981) and choose an option offering the best outcome. Inconsistencies of choice under risk conditions are attributed to variations or errors in framing or perceiving acts and outcomes.

Consumers consider sets of product or service attributes by using different rules, depending on aspects such as the complexity of the decision, and their involvement in it (Solomon 1996). However like many behaviours performed in everyday life that regularly involve strongly associated routines (e.g., prefer a certain brand of detergent, catch the 006 bus to go to work) consumers do not go through deliberate decisional processes owing to frequent behaviour repetition (Aarts, Verplanken and van Knippenberg 1997; Betsch, Haberstroh, Molter, and Glöckner 2004; Triandis 1980). Aarts et al., (1997) contend that when the same behaviour is performed many times, one does not need to weigh the pros and cons to arrive at a choice, when habits are formed. Indeed subsequent behaviour may be associated with, and automatically triggered by, the specific situational clues that normally precede it. This is considered especially true in travel mode decisions, where the travel behaviour is often habitual, and decisions made in a rather 'mindless' automatic fashion (e.g., Banister 1978; Goodwin 1977; Verplanken, Aarts, van Knippenberg and van Knippenberg 1994).

Heuristics are mental rules of thumb that can be used to frame situations and are used to simplify otherwise complicated decision events (Bettman 1979; Kahneman and Tversky 1979) and reduce time and effort (Solomon 1996), and transaction costs (Grieshop, Stiles, and Bone 1992). Algorithmic decision processes, in contrast, involve detailed quantifiable methods where the problems and the solutions are clearly defined (Hudson 1979). Where the activity is *familiar and has become routine*, so do the decision processes leading to the choice. This is likely to be the case in bus commuters, who use heuristics or short- cuts in their selection of the most appropriate bus to catch. As Grieshop at al. (1992) explain, heuristics are less detailed and rely on past experiences or situations representative of the problem set at hand. Always buying the same brand, or the cheapest or the most expensive product, always going to the same bus stop, or catching the bus with the same number or route brand are examples of rules of thumb.

While decision heuristics may simplify choices and save time, Tversky and Kahneman (1981) also showed that decision heuristics often lead to *systematic and predictable errors* especially under conditions of uncertainty (Betsch at al. 2004). These systematic errors, also referred to as counter intentional behaviours or 'action-slips' (Reason 1992), occur when routinised decision makers maintain their routine even in the light of new evidence (e.g., Betsch et al. 2004; Ouelette and Wood 1998). That is, the more routine the behaviour, the more likely it is to follow the routine

Anecdotal evidence on the Auckland network suggests that these 'action slips' may be occurring when commuters choose their buses. As described earlier, patronage data indicates that commuters will wait for a particular brand of bus even when they are able to get to their destination on another branded bus. Similarly when route brands are employed to highlight a

particular route to consumers, if an alternative bus that is not route branded arrives they may choose to wait even if it carries the correct destination and number. This is substantiated by patronage data on a particular route in Auckland (Turnbull, pers. comm.) This occurs because brands differentiate products and services and if consumers are presented with a branded product about which they have formed a prior belief, even if presented with the evidence to the contrary they will not accept the alternative. This is the case in many areas in Auckland where the commuter is presented with multiple brands and amplified because of the practice of independent tickets. This situation creates loyalty to a brand rather than the desired effect of allowing commuters to optimise the convenience of the entire system, (Ford and Smith 1987; Roedder-John, Scott and Bettman 1986; Solomon 1996).

Prior experience does have an effect on decision-making processes but the relationship is not straightforward. Experts and novices differ in where they search for information. In contrast to experienced users, novices 'are more likely to rely on opinions of other people and upon 'non-functional attributes' like brand name and price to distinguish among alternatives,' (Solomon 1996, p277)**.** One might also expect that the level of search for alternatives might also be related to experience. So for example one might expect that novices who know little about the bus system would search more to determine the alternatives to optimise their travel choice than experienced users. In actuality, Bettman and Park (1980) showed that there is an inverted-U-shaped curve between knowledge and external search effort. Novices tend not to know where to start and don't spend a lot of time searching for alternatives, choosing from things that are more familiar. Experienced people who have a lot of knowledge also may not search a lot. Instead they rely on their own memories for information. On the other hand people who are moderately knowledgeable tend to search the most.

This study aims to investigate:

- What type of commuter is more likely to know the network the best (bus alternatives available)?
- What cues do people look for when deciding on the correct bus to catch? The criteria or heuristics used to select a bus?
    - What is the typical processing order of these cues?
    - What role do brands play compared to other cues?
    - Does prior experience affect the use of heuristics
        - What cues are used by frequent commuters versus infrequent commuters?

The results are then used to make recommendations to make the bus network more comprehensible

Method

Commuters were interviewed at pre selected bus stops on four major corridors in Auckland. Commuters travelling within a corridor had a range of alternatives to destinations along the corridor. Interviewers interviewed 260 respondents waiting at these bus stops. The survey instrument was developed by the authors with input from technical specialists in public transport. It was pre tested with 20 commuters at central city bus stops. Final revisions were made prior to use. Question categories included;

- Respondent destination,
- Frequency of travel,
- Type of ticket,
- Whether they knew they had a choice of buses,

- Whether they came to the same stop for this destination,
- Attributes they used to select the most appropriate bus and,
- Knowledge of buses available from a photo collage of different buses, (some of these were correct and others were incorrect).

Interviews were conducted at the morning and afternoon peaks.

Categories of commuter

To distinguish which commuters understood the network best (had the best knowledge of options available), commuters were categorized on three dimensions; frequency of use, how the fare was paid and degree of familiarity with the stop.

Frequency of use: Commuters were asked 'how often do you travel?' They were prompted if required. Their selections were categorised into 'Regular', 'Irregular' and 'Never Before' (Table 1).

Table 1. Frequency of use

Frequency of use category	**Options for travel frequency**
Regular user	4 or more days per week
	1-3 days per week
Irregular user	Once a fortnight
	Once every 3-4 weeks
	Less than once a month
Never before	Never caught a bus before

How the fare was paid: Commuters were asked what type of ticket normally used on this journey they. This included the option of a cash fare. It was assumed that those who purchase multi-ride tickets beforehand are more likely to be regular users who are more familiar with the network and potential options available.

Familiarity with the stop: Commuters were asked whether they always came to this stop to make this journey. Commuters who always come to the same stop may be more familiar with the buses going past the stop.

Definition of knowledge of bus options

Commuters were shown a photo collage of different buses, some correct and some incorrect. They were asked 'if any of these buses arrived at the stop, would you catch any to go to your destination.' Their responses were coded into groups (Table 2).

Table 2. Categories of knowledge

Code	Category	Meaning
1	All correct	All possible buses were selected correctly
2	Some correct	Options chosen were correct but some correct options not chosen
3	More correct than incorrect	Options chosen included more correct ones than incorrect ones
4	More incorrect than correct	Options chosen included more incorrect ones than correct ones
5	All incorrect	No options chosen were correct
6	Not sure, did not know	Not sure, did not know which bus options were correct

Cues used to identify correct bus

Respondents were asked what they looked for to choose the correct bus to catch, (Table 3). They were prompted on order. The order was recorded for cues used. The analysis was conducted using Kendall's coefficient of concordance approach (W) as follows.

Typically used as a measure of interjudge reliability, or to test the reliability of different evaluators of the same subject Churchill and Iacobucci 2002), Kendall's tau (W) (Kendall and Gibbons 1990) is a non-parametric (distribution free) measure of association among three or more rankings of n objects or individuals. This is unlike the more commonly known Spearman's rank correlation coefficient, which deals with two variables per object. For a comparison of various correlation coefficients see Babakus and Ferguson, (1988). Normally each respondent would be expected to rank all n objects, but by applying a random assignment of objects to randomly selected respondents, and assessing respondent characteristics, we can apply the assumption of randomisation taken from experimentation. (See Churchill and Iacobucci 2002 p 150 for an explanation.)

Table 3. Cues for identifying the correct bus

Colour of bus
Route number
Time
Destination
Route brand
Operator brand
Ticket
Any bus that turns up
Other

If we were applying W to a test of interjudge reliability we would be primarily interested in the W test statistic, but that is really just a means of checking the validity of the rankings. Kendall and Gibbons (1990) suggest that the best estimate of the true rankings of n objects is provided by the order of the various sums of ranks (R_i) when W is significant. The R_i is simply

the sum of respondents' rankings for each object. The limits of *W* are zero with no agreement and one with perfect agreement.

Results

What type of commuter is more likely to know the network the best?

Several choices of buses were available to all commuters sampled. Respondents were asked whether they had a choice of buses to reach their destination.

Approximately 30 % of all users (n=260) were not aware of their choices of buses. Negative responses and 'don't know' were categorised as not aware of choices.

Degree of experience: Frequency of use affects knowledge. Regular users were more knowledgeable than irregular commuters. And new users were least knowledgeable. Expressed knowledge of options is significantly different between the different groups of commuters, (X^2= 44.7, p<0.01, df=4, n=260). Regular users for whom the decision is routine (e.g., make 1 or more trips per week), are most likely to know they had a choice whereas first time users are least likely to know. Irregular users display an intermediate level of knowledge.

Almost 70% of people who are new to the system ('never before used') and for whom this is not a routine behaviour are not aware of their choices (Figure 1). About two thirds of irregular commuters are aware they have an option to make this journey, compared to three quarters of regular commuters.

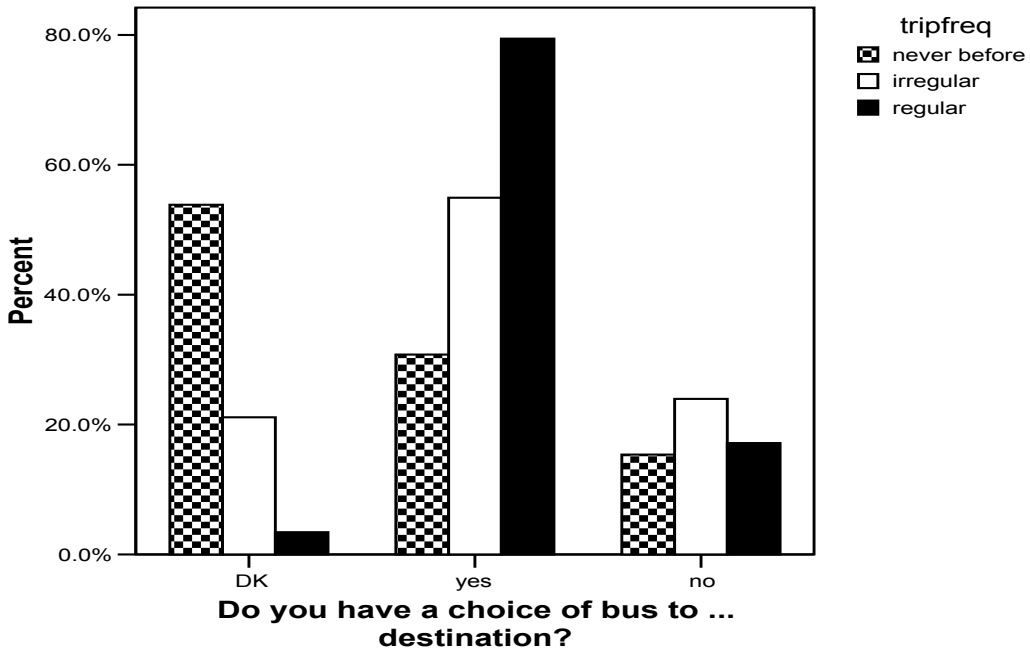

Figure 1 Are commuters aware of their choices?

How fare is paid: The assumption was that regular users are more likely to use tickets than cash. This was confirmed, as Figure 2 shows, regular users are more likely to use cash than tickets compared to other types of commuters (X^2=17.24, df=2, p<0.01, n=254).

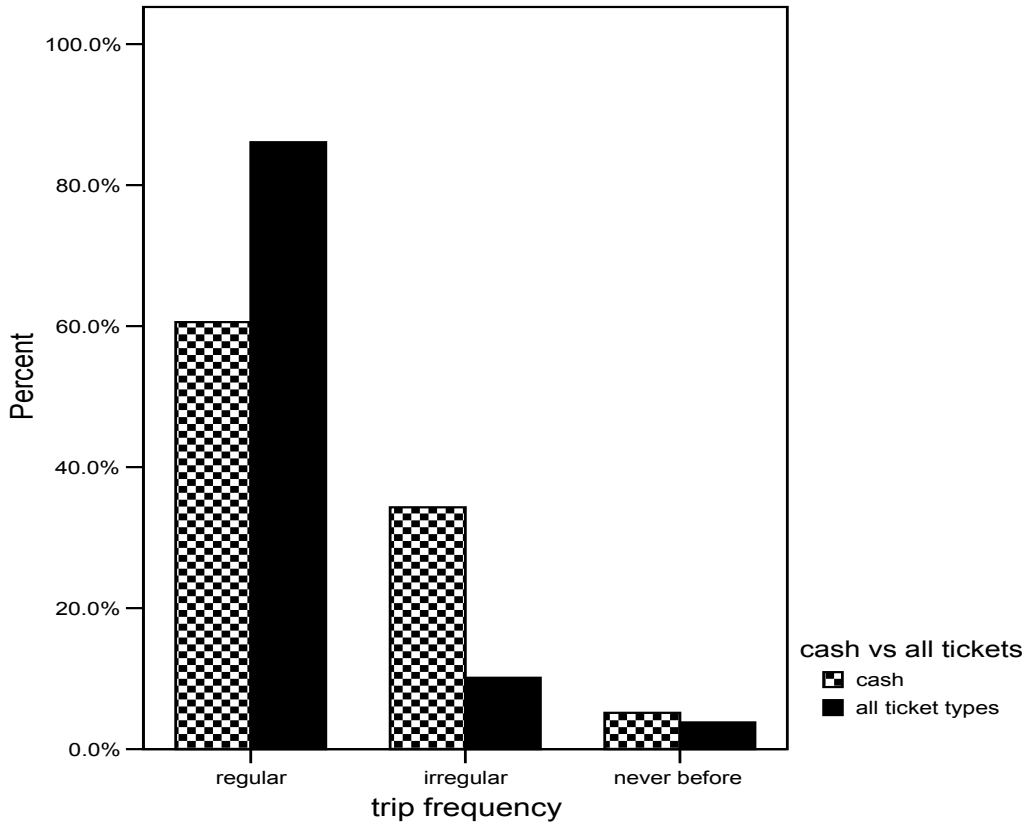

Figure 2 Percentage of commuters who use cash versus tickets

However there is no statistical difference in knowledge between people who pay cash or who purchase some form of ticket. The proportion of people who were aware of their options was similar whether they purchase tickets or not. For ticket purchasers 77% were aware of options vs 23% not aware and for commuters who used cash 67% were aware of options versus 33% not aware of options. Negative responses and 'don't know' were categorsied as not aware of options.

Familiarity with the stop: Commuters were asked whether they normally come to this stop when they travel to the destination they were going to on the day of the survey. The assumption was that regular users would typically use the same stop compared to irregular users. They would therefore be more familiar with the bus alternatives at that stop.

Figure 3 describes which commuters used the same stop to make a trip. Overall 62 % of commuters go to the same stop to make a trip (n= 247). There was no statistical difference in the type of commuter who used the same stop for a particular journey. Regular and irregular

commuters tended to go to the same stop to make this particular journey (65% of regular user (n=176) and 55% of irregular users (n= 71) use the same stop for this trip, Figure 3).

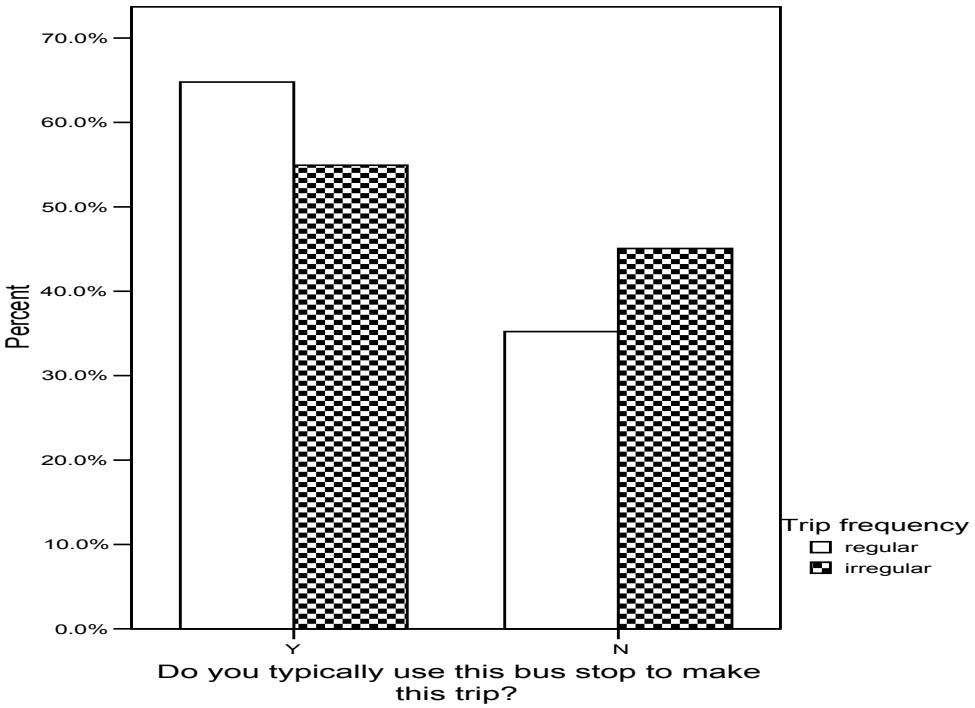

Figure 3 Which commuters typically use the same bus stop?

There were no differences in the knowledge of users based on their familiarity of the stop ('who always come to this stop to travel to this destination' versus those who use different stops). Commuters who were familiar with the stop where they were sampled showed a similar distribution of awareness of options as those who were not familiar (Figure 4). For instance 78% of commuters who came to the same bus stop said they had a choice and 68% of commuters who did not go to the same bus stop said they had a choice. And a similar proportion of people thought they had no choice whether they used the same bus stop or not.

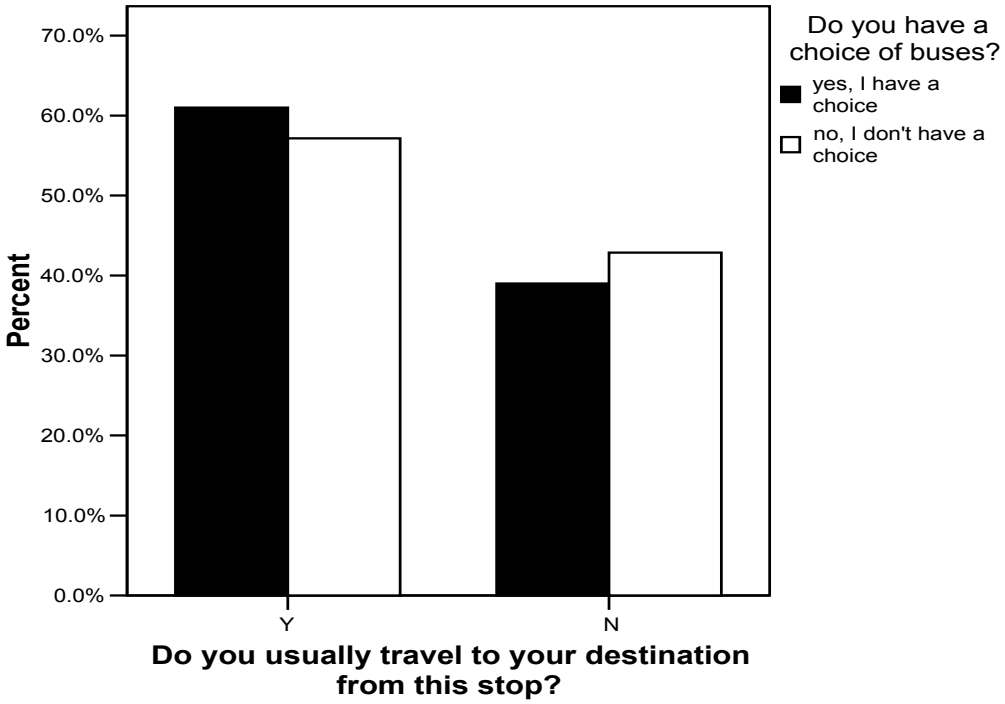

Figure 4 Are commuters aware of their choices if they are regular users of the bus stop?

What criteria do commuters use to select a bus and what is the typical processing order for a selection decision?

Typical cues and order: Commuters typically search for quite specific cues, route number first, then destination, followed by colour of the bus (Table 4). Brands (route or operator) are used less, possibly because there are so many operator brands, and route brands (i.e., brands that identify particular routes) are not common.

Experienced and inexperienced commuters: Experienced commuters use different cues to select their bus compared to irregular commuters. Regular or experienced commuters typically identify their bus by route number first, then by colour of the bus or destination (Table 4). Irregular commuters typically identify the correct bus first by destination, followed by route number, and then any bus that turns up.

Table 4. Comparison of rank order of cues used by commuters to identify their bus

	All commuters (n=259)	Regular (n=175)	Irregular (n=71)
Colour of bus	3	2*	4
Route number	**1**	**1**	2
Time	7	7	8
Destination	2	2*	**1**
Route brand	5	5	5
Operator brand	6	6	6
Ticket	8	8	7
Any bus that turns up	4	4	3
Other	9	9	9

* tied

Specific routes: Commuters used significantly different cues on different routes. On the route with a clear route brand (Route 1, Table 5), commuters selected buses on route number and destination. Colour of the bus was a lower option. Where the route brand coexisted with other operators (going to the same or different destinations; Routes 2 and 3 consecutively) commuters used; (1) colour of the bus, (2) destination where buses could diverge off a corridor; Route 2) and (3) colour of the bus and route brand where there was a common destination even for buses not route branded (Route 3). The top three cues were common for these routes (colour, destination and route brand), which seems to suggest that commuters choose to rely on simpler clues other than route numbers where this is possible. Reliance on simpler clues is reinforced even where there are several different colours of buses operating but where the destination is clear, standardized and the route is common. In this case (Route 4) commuters catch any bus that arrives. They might check destination, and then colour. Where commuters can employ simple cues, route number falls to fourth (Routes 2 and 3) and fifth ranked (Route 4). However on the route branded route with a single operator (Route 1), route number is used first, primarily because the services on this corridor do not use a common route for the entire journey of the route brand. Buses carrying this route brand can diverge off the corridor and go to a variety of destinations. To reduce the risk commuters use route number and destination rather than route brand.

Commuters rely on simple cues or are so confident they catch any bus where there is one route and a clear destination with a standard name so that the corridor is clearly demarcated. This is the case even where the stop offers a complex set of options (multiple operators with different liveries, Route 3). People will opt for the route branded option and not search route numbers where it leads them to the same place.

Where a prominent route brand is employed, but is sometimes inconsistent (unbranded buses are used to cover the route) and the branded buses carry distinct route numbers and names, commuters disregard the colour of the bus in preference for route number and destination. In this case the corridor is not clear and commuters face a risky situation even though the brand personifies a standardized route.

Commuters did not rely on operator brands to catch their buses. However they did use colour to distinguish their correct bus options. Route brands tended to be used ahead of operator brands where they existed (Routes 1-3).

Table 5. Comparison of rank order of cues used by commuters on particular routes to identify their bus.

	Route branded			*No route brand*
Operator number	*One*	*Many*		*Two*
	Different destinations	*One route, one destination*		
	1.One livery sometimes inconsistent (n=46)	*2. Route brand operates among several operators going to other destinations, no sign (n=50)*	*3. Route brand operates among several operator liveries, standard destination sign (n=42)*	*4. Two operator liveries, standard destination sign (n=35)*
Colour of bus	3	**1**	**1**	3
Route number	**1**	4	4	5
Time	5*	6	7*	8*
Destination	2	2	3	2
Route brand	5*	3	2	8*
Operator brand	7*	7	6	4
Ticket	7*	8*	9	7
Any bus that turns up	4	5	5	**1**
Other	9	8*	7*	6

*tied

What is the commuters' actual level of knowledge of options on the network?

Commuters were shown a photo collage of buses, some correct, some incorrect. They were asked to indicate which if any of those buses would they use to go their destination. Experienced commuters were significantly more likely to know the options available than irregular commuters, ($X^2 = 24.42$, df =10, $p<0.05$, n=260; Figure 5).

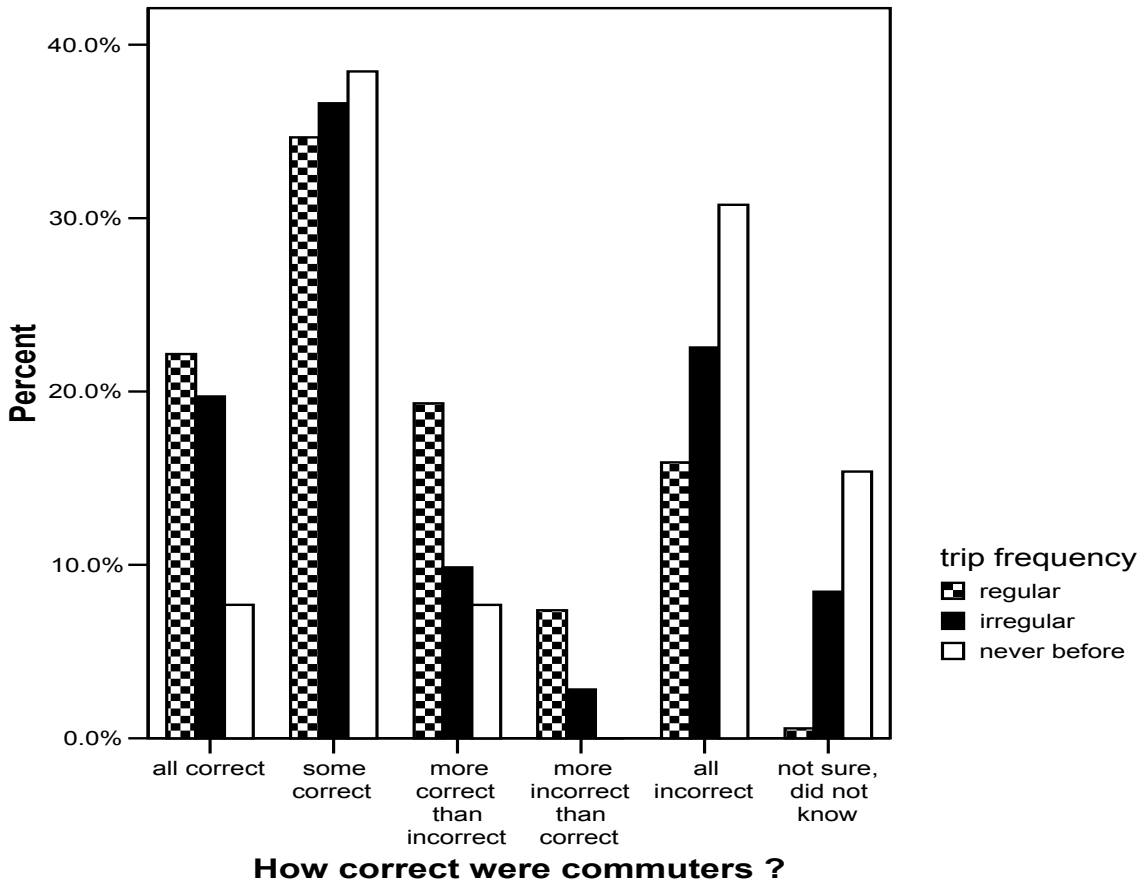

Figure 5 Commuter knowledge of the bus alternatives.

However the proportion of commuters who understand the network options at their stop are lower than expected. Less than a quarter of regular users, 19% of irregular users and 7% of new users knew all options. A far higher proportion of all groups got 'some correct,' (35% regular, 37% irregular and 39% of new users). This group knew a set of correct options or perhaps a single option but were unaware of others ('some correct'). In the case of new users they were looking for one bus.

The error rate is relatively high. Thirty percent of new users got all options incorrect. Just under a quarter of irregular users chose incorrect options.

Discussion

What type of commuter is more likely to think they know the network the best? In the first part of the study we tested whether commuters knew if they had options of buses to catch. Frequent users are more aware of options; they also have a tendency to be more routine in their behaviour than irregular users as they use the same stop more often than different stops. They also take advantage of concessions offered by tickets versus cash fares, which may mean that they are tied to the tickets of particular operators, which in turn may limit options. This suggests they have adapted to a fragmented system.

In the second part of the study we tested whether they could distinguish correct from incorrect options. Only a small proportion of commuters knew the correct set of options for the particular stop investigated. A far higher proportion knew a few buses that were available and were completely unaware that there were others. The system appears so complex that a high proportion of regular users have incomplete knowledge. While regular users know more correct options than their counterparts, most users, whether they are regular, irregular or first time commuters, rely on a subset of options or a single option. They satisfice rather than optimize. This was compounded where the options were greater at busy stops. The error rate (i.e., getting it completely wrong) in knowledge is relatively high among new users (30%) and irregular users (24%). This should be a major concern for planners and operators alike. This suggests that irregular commuters who have lower knowledge of potential options (all the potential route numbers that might get them to their stop) face a higher risk and rely on knowing a particular destination. While this reduces the perceived risk it also ensures that they end up waiting for particular buses rather than making the most of all options. As a consequence bus operators will continue to face overcrowded and empty buses as irregular users wait for an option that they are familiar with. The ramifications for capacity for operators and efficiency for passengers are obvious.

The third part of the study investigated the cues used by commuters to identify their bus options.

Commuters use a range of cues to identify the correct bus. As expected, prior experience did have an effect on decision-making. Overall regular users use different cues to irregular users and seem to search differently. Regular commuters look for route number, colour of the bus and destination, whereas irregular users typically look for the destination first, then route number and resort to 'any bus that turns up' and perhaps ask the bus driver. Regular commuters are more likely to rely on the colour of the bus (which is also a cue to the brand) than irregular users, perhaps because this allows them to reduce their search. Instead of searching every bus that appears for the destination, they use the route number to indicate a set of options possible and then check colour and destination to make certain. However it may also relate to their use of tickets, which limits options to particular bus operators and therefore predisposes them to search for a particular coloured bus livery. Irregular users are less likely to know the operator or livery so their search involves finer clues such as destination and route number.

These findings suggest a similar relationship in searching options to that described by Bettman and Park (1980) for novices and experienced customers. Neither novices or experienced users used the complete set of options to select their buses, instead they both used limited search cues Experienced, regular users used the surrogate of bus colour and tended to rely on a few correct options for their bus, rather than being fully familiar with all options

There is some evidence that experienced commuters are making *systematic errors*. On the route with many options and many operators, commuters tended to rely on the colour of the bus, followed by the route brand which suggests that the route brand that operates on this route is the most popular option for many users despite there being many other options available. It suggests that behaviours have become routine and that people rely on the success of past behaviours rather than looking at the evidence (destination signs) which indicates all available options.

The comparison of the different routes provides some evidence that commuters will learn and can optimize where the system is easy. Commuters on different routes show a tendency to use a different order of cues depending on the situation. Where the system is less risky (Route 3) and all buses are clear options, commuters typically catch any bus going to the destination with a standardised name and they look for colour and then operator brand, and are less likely to rely on route number. This has advantages for capacity planning of the bus operators as well as increasing efficiencies for travellers and making it a fast and attractive choice for commuters.

One would expect that wherever routes are colour coded by route brand then commuters would rely on the simple heuristic of colour. However if the cue cannot be relied on and is not a consistent indicator then it becomes irrelevant, and worse may add to the visual fragmentation. For instance, if the route brands are sometimes replaced by non-route branded buses, or the buses do not use a common route for the entire journey (different route numbers and destinations on the route branded bus) then the advantages of colour coding are lost. Commuters appear to perceive this as risky and search for route number and destination, and the brand is unnecessary. In this case using the route brand ONLY on the common corridor and clearly demarcating the point at which buses diverge off the corridor would make the route brand meaningful and assist these commuters. Where the route brand is consistent and there is a common route and destination, then commuters use simple cues like colour or route brand. Even where the stop has a complex set of options with many operators using a common route and destination, where they have the options of a route branded bus as well; they search for colour and route brand, seemingly to reduce the complexity of search and perceived risk.

How can we use the knowledge about processing order decisions to make it more legible and so get the full potential from the network? The majority of users have incomplete knowledge and the error rate is relatively high. Commuters are satisficing rather than optimizing because the system is hard to understand. Catching public transport is a low involvement decision and commuters appear not to want to spend a lot of time searching alternatives, which is consistent with Einhorn and Hogarth's (1981) contention that consumers make decisions based on adequate choices rather than optimal ones. In other words, in this system commuters make adequate choices based on a subset of options and they get to their correct destinations but not as quickly as they would have if they had been able to optimize their decision based on the knowledge of all options available.

To reduce the risk and reduce search effort regular users rely on past routinsed behaviour to identify options. While they may be more familiar with the complex route numbering system than irregular users they tend to rely on a limited set of correct options. It appears even their options may also be limited by the company specific ticketing system of bus operators. On the other hand, with only limited experience, irregular users have to check every destination then route number, and if all else fails ask a bus driver on any bus that arrives. Irregular users have more flexibility because they tend to pay cash, which allows them to try other operators. However to take advantage of these options requires that they understand the route numbering system. There is no evidence that this is the case.

Interestingly the results indicate that commuters use many cues and heuristics to catch their bus prior to employing operator brands. As operator brands were of less significance to commuters' decisions compared with colour, an argument can be made to reduce the prominence of operator brands, thus reducing the visual fragmentation caused while using

colour to highlight routes and thereby increasing the legibility. Brands are important as the results indicate that route brands can assist bus choice. However as previously discussed, they need to be carefully designed to reduce risk.

This discussion has focused on commuter trips. However another strategy for planners should be to increase the share of trips taken by public transport. This means encouraging people to use public transport for other destinations with which they may be unfamiliar. This study suggests that regular passengers may be less likely to undertake these trips where they carry an operator ticket or where they needed to search for new route numbers. They are operating in the present environment on fewer options than are available, which suggests that time or effort required to search other options even on regular trips is too much. Can we expect them to take the time and effort required to search options for trips they may now make in a car?

Persuading irregular and new users to undertake trips to new destinations is even more difficult as they operate on very limited options now, and the rate of errors is relatively high. Placing themselves in a risky situation where they may get on the wrong bus or waste time waiting for exactly the correct destination may be too much of a barrier for them to explore other destinations using public transport where the bus numbering system can be obscure.

Recommendations

To make the network less complex and more easily used, the results suggest that there is a need to maximize regularly used clues, minimize irrelevant clues and enhance options for choosing the best options regardless of operator. Such changes would include the following.

- Reduce the prominence of operator brands
- Colour code corridors with route brands, the corridor must have a clearly defined beginning and end
- Define the colour-coded corridor by using a standard destination name and a standard descriptor
- Ensure that where route branded colour coding is employed that it is consistent and reliable (or it will be an expensive and confusingly irrelevant cue)
- Review ticketing to create a common ticket across all operators which increase the number of number of options available to commuters

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