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Fandangles and other Measures of Incidental Trips

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Abstract. The Washington Post article of April 2005 "*Pursuit of a Grande Latte May Be Stirring Up Gridlock*" has created considerable debate in the transport planning and travel survey community about the role of incidental trips. This paper examines the concept of trip incidentality, where trip incidentality is defined in terms of the effect on total daily travel distance of removing (or not recording) specific activities from the daily set of activities. The paper proposes four measures of trip incidentality (Fandangles, Reflexive Trips, Totally Incidental Trips, and Trip Length Shortfall), and applies these measures to a travel survey data set collected in Brisbane, Australia in 2003-2004. Several findings concerning the measurement of daily travel are of importance. While trip rates have traditionally been used to measure daily travel, it is shown that 50% of trip stages could be removed from the data set and only 20% of travel time, 8% of trip stage distance and 3% of trip chain distance would be lost. These findings question the robustness of using trip rates as the primary means of measuring daily travel patterns, especially when the data is to be used in the development of transport network models.

The paper further explores the extent of trip incidentality as a function of several trip and activity characteristics. It is found that activities are less likely to be incidental if they are for work, education or recreation purposes, and are more likely to be incidental if they are at the end of a public transport trip stage or are during peak periods. They appear unaffected by the length of the trip stage preceding the activity, but are highly influenced by the duration of the activity itself, with shorter duration activities being much more likely to be incidental. The findings are then used to comment on the veracity of the Washington Post article's observation that "Researchers say the craving for gourmet coffee may add mileage to the morning rush and also complicate efforts to reduce traffic, save fuel, and reduce air pollution".

INTRODUCTION

The Washington Post article of April 2005 "*Pursuit of a Grande Latte May Be Stirring Up Gridlock*" has created considerable debate in the transport planning and travel survey community. Their comment that "Researchers say the craving for gourmet coffee may add mileage to the morning rush and also complicate efforts to reduce traffic, save fuel, and reduce air pollution" has stimulated many to re-consider the role of incidental trips in the overall patterns of travel, and to examine the modelling and travel survey implications of incidental trips.

At the same time that this debate was occurring in the USA, a different but related debate was taking place on the other side of the globe. Following the completion of the South-East Queensland Travel Survey (SEQTS) in Brisbane, Australia (*1*), discussions were taking place as to which was the most appropriate measure of travel in an urban area. Traditionally, trip rates (at the person or household level) have been used as the primary means of summarising the extent of travel in an urban area, with most cities reporting between three and four trips per person per day. However, the definition of trips can be rather subjective (e.g. are "trips" to several shops within a shopping mall counted as separate trips, or is the "trip" to the shopping mall just counted as one trip?), and hence the meaning of trips per person per day can vary substantially between cities, or within one city from survey to survey. Perhaps one should measure travel in some more fundamental way, such as by time spent travelling (as is used in many Travel Time Budget studies) or by distance travelled (which is especially important in environmental studies where distance driven by car is a factor of considerable importance).

These two streams of thought intersect because the type of trip described in the Starbuck's Effect is an incidental trip (dropping in for a coffee on the way to work). While it might be counted as a "trip", it may not "add mileage to the morning rush" as the Washington Post states if there is little or no deviation from the main trip (to work) in order to get the coffee. Adding such a trip to an established travel pattern may not increase mileage, and conversely removing such a trip may not decrease mileage.

The purpose of this paper is to explore how such incidental trips might be measured, the extent to which such incidental trips exist in a typical city's travel patterns and the effect which removing (or not recording) such trips might have on overall travel patterns, especially if trip rates are not used as the prime measure of travel behaviour. Data from the SEQTS survey will be used to illustrate the various empirical points made in the paper.

DISTRIBUTIONS OF TRIP LENGTH

In any travel survey, the measurement of distance travelled (either by direct questioning or preferably by calculation from the geocodes of trip origin and destination) is of prime importance. When the travel survey data is used in network modelling, it is the distance travelled that is more important than the number of 'trips" made, because traffic flows on a network are more a measure of network exposure than they are of trip rates. For example, several very short trips make little difference to the flows observed on the network, whereas one long trip can have considerably more impact.

The SEQTS survey in Brisbane (*1*) used an activity-based trip-stage framework for the collection of travel data. A trip stage is defined as a piece of travel with one purpose and one mode of travel. The cumulative distribution of the trip stage lengths (measured in kilometres) is shown in Figure 1. It can be seen that 15% of trip stages are less than 0.5 km (and hence round off to zero in Figure 1), 50% are less than 3 km, while 90% are less than 15 km. Such figures would be common around the world for a city of the size and population of Brisbane (about 1.5 million).

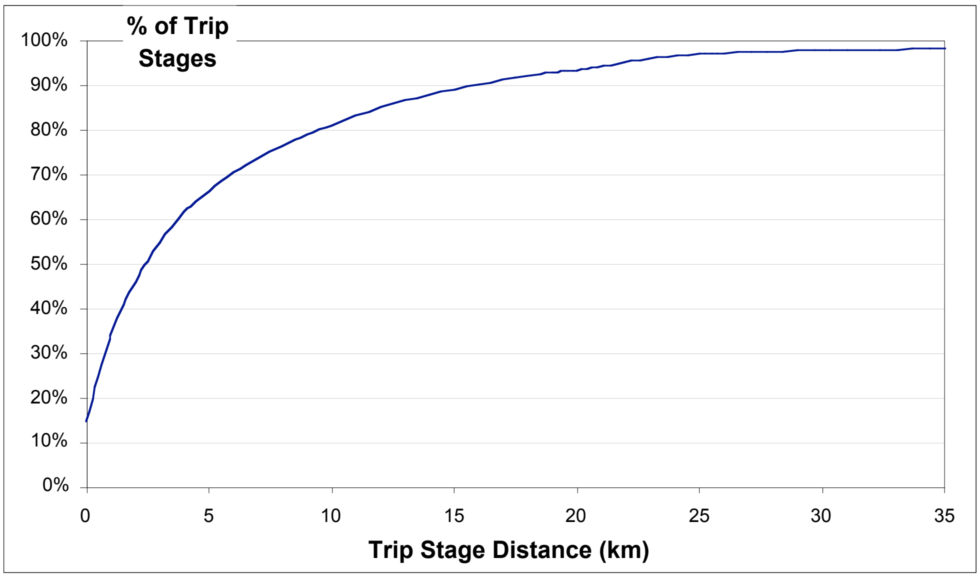

FIGURE 1 The Cumulative Distribution of Trip Stage Lengths (km)

Inequality in a range of socio-economic variables, such as income, is often described by means of a Lorenz Curve (and summarised numerically by a Gini Index). This same technique may be applied to trip lengths, by plotting the cumulative proportion of trip stages against the cumulative proportion of distance accounted for by those trip stages, as shown in Figure 2.

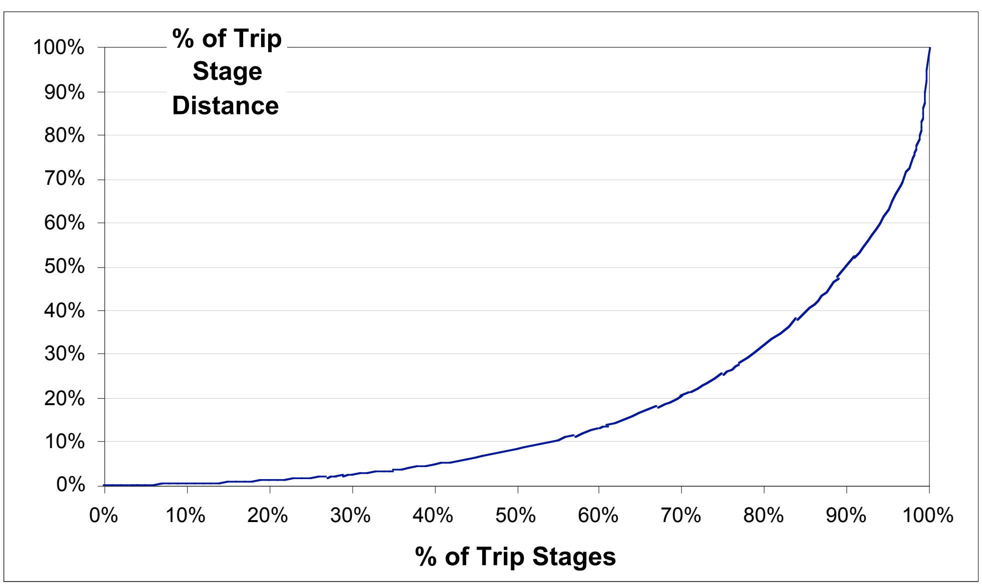

FIGURE 2 A Lorenz Curve of Trip Stage Lengths (km)

This curve may be understood by noting that the shortest 80% of trip stages account for only 30% of the total distance travelled. Conversely, the longest 20% of trip stages account for 70% of the total distance travelled.

The significance of this curve is considerable when examining travel surveys and network modelling. If the main purpose of the travel surveys is to collect data for the building and calibration of network models (which it still is in many cities, despite the academic rhetoric about obtaining a deeper understanding of travel behaviour!), then the main objective of the surveys is to capture the majority of distance travelled (since this is what will show up as traffic flows in a network model), rather than capturing the majority of trips made. By reference to Figure 2, it can be seen that the shortest 50% of trip stages could be omitted (i.e. not recorded in the survey) and only 8% of the travel distance would be lost. That is, the trip rate could halve but the travel distance would still be 92% of the true value. This is a sobering observation for those trying to compare trip rates between surveys, without considering travel distances. A similar Lorenz Curve for travel time would show that the longest 50% of trip stages make up 80% of total travel time.

SOME MEASURES OF TRIP INCIDENTALITY

The above analysis, while sobering, is flawed. The length of a trip stage is not a particularly good measure of travel resources devoted to getting to the destination at the end of the trip stage. For example, consider the trip to Starbucks for that early morning coffee. If the Starbucks is near your home, then the trip <u>to</u> Starbucks would be short, while the following trip to work could be long. On the other hand, if the Starbucks is near your workplace, then the trip <u>to</u> Starbucks could be long while the following trip to work would be short. In neither case is the length of the trip <u>to</u> Starbucks a good measure of the travel resources (time, money, effort, pollution etc) required to go to Starbucks. What is needed is a measure of the extra resources needed (or costs imposed) to make the trip to Starbucks, assuming that the trip to Starbucks is incidental to the main trip purpose of going to work. This paper proposes four such measures of trip incidentality.

Fandangles

This first, and most fundamental, of these measures is termed the Fandangle. The name of this measure has nothing to do with a Texas festival, or a punk rock band, a restaurant or an item of jewellery (as one might think from a casual Google search!). Rather it is derived from the conjugation of the two words “fanned angle” and is also named after the graduate student who first used the measure in travel pattern analysis (Miranda Fan, *2*). The concept of a Fandangle is deceptively simple, as illustrated in Figure 3. Consider a chained trip from coordinates (x_1, y_1) (say, home) to (x_2, y_2) (say, Starbucks) and then on to (x_3, y_3) (say, work). The Fandangle is the “fanned angle” from the continuation of the bearing of the first trip to the bearing of the second trip. The greater the Fandangle, the more out-of-the-way the first destination is, on the way to the second destination. Fandangles can range from zero up to 180 degrees, where a zero degree Fandangle represents no deviation on the way to the second destination in order to visit the first destination, while a 180 degree Fandangle represents turning around and going back the way you just came (as would happen in a simple out-and-back round trip from an origin).

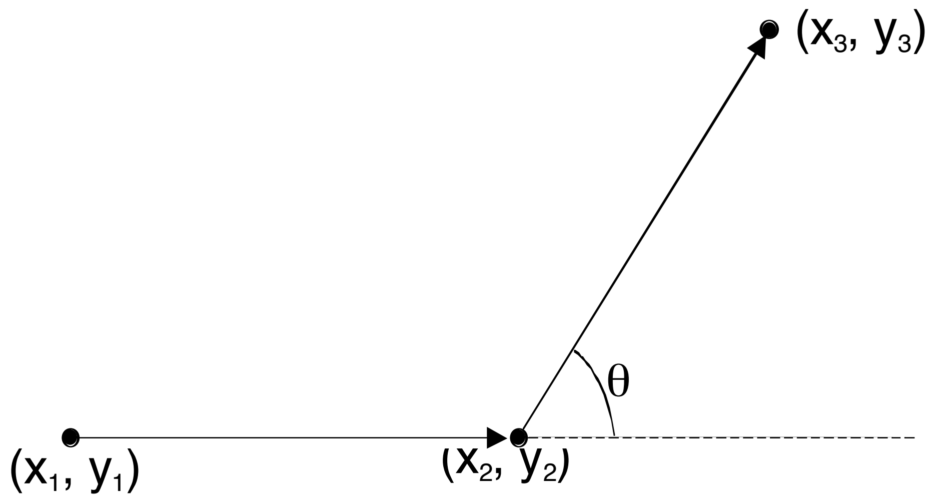

FIGURE 3 The Definition of a Fandangle, θ

Reflexive Trips

A special category of Fandangles is the 180 degree Fandangle, which we have termed as Reflexive Trips, since they turn around and go back where they came from (not necessarily to the same place, but just in the exact opposite direction from where they just came). This type of trip is special, because network models often implicitly assume that all, or at least most, trips are of this format. This occurs when network models are not very good at handling trip chains and non-home-based trips, which are now becoming the dominant trip type. A Reflexive Trip implies that the activity at the destination was either so important that it warranted a trip to that location purely for that purpose, or that the destination was so poorly located that it was totally out of the way and not on the way to anywhere else.

Trip Length Shortfalls

The Trip Length Shortfall is the reduction in total travel distance if an activity at a particular destination was not performed. Alternatively, it is the reduction in total reported travel distance if the activity was performed, but simply not reported in a travel survey. The Trip Length Shortfall is defined as shown in Figure 4 as (A + B) - D. That is, if the first destination was visited, then the total distance to get to the second destination would be A + B. However, if the first destination was not visited, then the trip distance to the second destination would be D. The reduction in total distance travelled would therefore be (A + B) - D. Alternatively, if the first destination was visited but not reported, then the Trip Length Shortfall in total travel distance would be (A + B) – D. Clearly, the Fandangle and the Trip Length Shortfall are related. If the Fandangle is zero, then the Trip Length Shortfall is also zero, since it doesn’t matter whether the first destination is visited (or reported) or not; the total distance to get to the second destination is D, which is equal to A + B. As the Fandangle increases, the probability of a higher Trip Length Shortfall also increases. It does not necessarily increase, because it depends on the relative proximity of the three locations, but the possibility of a high Trip Length Shortfall increases as the Fandangle increases. (the astute reader will have noticed by now that all the above arguments are based on straight-line trips between origins and destinations; the same logic applies when using network paths, but the calculations become more involved).

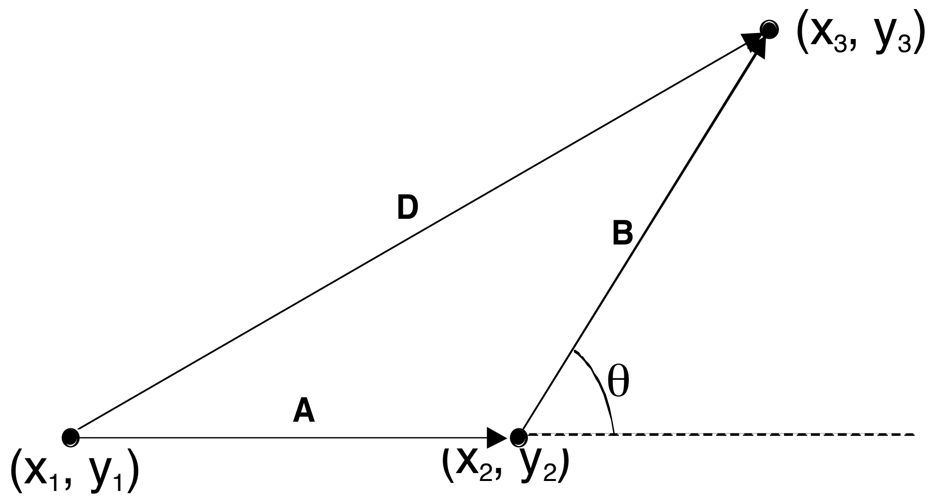

FIGURE 4 The Definition of a Trip Length Shortfall

Totally Incidental Trips

The final measure of trip incidentality is the proportion of Totally Incidental Trips. These trips are virtually the opposite of Reflexive Trips, and occur when the Trip Length Shortfall is zero, which means that the Fandangle is also equal, or very close, to zero. Totally Incidental Trips are basically on the direct route to somewhere else. They can be removed, or not reported, and there will be no effect on the total (reported) travel distance.

Some Overall Results from SEQTS

To illustrate the application of the above measures of trip incidentality in a real-world context, consider the results obtained from the SEQTS survey. The cumulative distribution of the Fandangle for all trip stages (except the last trip stage of the day, for which there is no following trip stage with which to calculate a Fandangle) is shown in Figure 5.

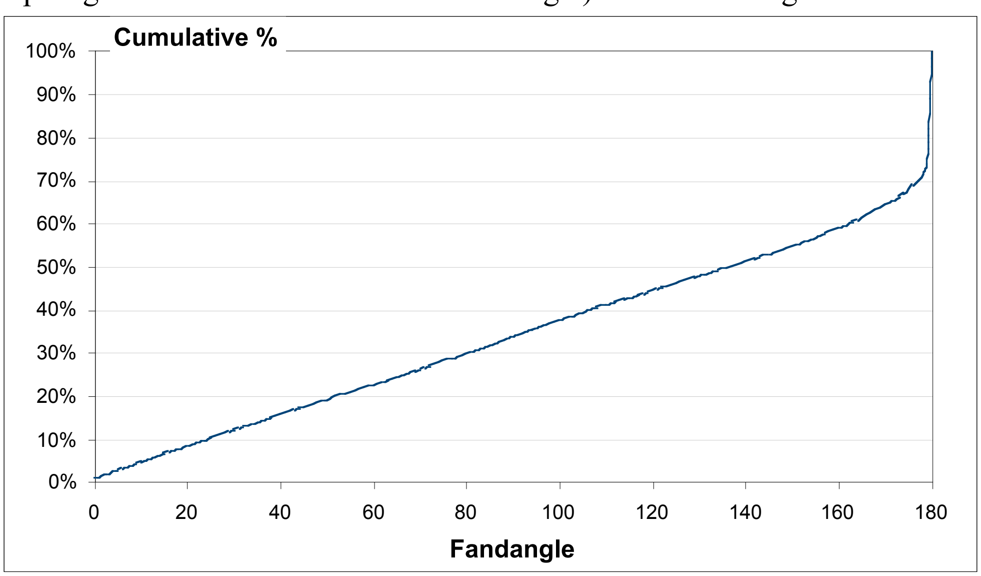

FIGURE 5 Cumulative Distribution of Fandangles for SEQTS

Only 1% of trip stages have a Fandangle of exactly zero. About 25% of trip stages are Reflexive, in that they have a Fandangle of 180 degrees. In between these two extremes, the distribution is essentially flat, with the exception of a small region close to 180 degrees. What this means is that apart from the 25% of trip stages that come back in the direction from where they have just been, the remaining 75% of trip stages have no preference for the direction they take after the first destination; they are equally likely to head of in any direction! They are no more likely to continue in the general direction in which they have been heading, as they are to turn back from the direction in which they were originally heading. This finding has interesting implications for the geographic simulation of trip chains.

The cumulative distribution of the Trip Length Shortfall for all activity locations (except the first and last locations of the day, which have no surrounding activity locations) is shown in Figure 6. It can be seen that 11% of activities create Totally Incidental Trips, in that they have a Trip Length Shortfall of zero. This 11% of Totally Incidental Trips is higher than the 1% of zero Fandangles noted above, because a zero Trip Length Shortfall (to a given number of decimal places) can occur even when the Fandangle is only close to zero. Thus, 11% of trip stages (or activity locations) could be removed (or just not reported) and the total travel distance would not change.

FIGURE 6 Cumulative Distribution of Trip Length Shortfalls for SEQTS

While Fandangles and Trip Length Shortfalls are measuring a similar concept, they are not mathematically equivalent. The relationship between the two measures of trip incidentality is shown in Figure 7. It can be seen that there are four distinct regions in the relationship. From absolute equality at zero up to nearly a 90 degree Fandangle, there is a near-linear relationship with Trip Length Shortfall. Around 90 degrees, there is a momentary blip in the relationship. From 90 degrees to about 135 degrees, the relationship is flat with a constant Trip Length Shortfall of about 2.0 kilometres. Above 135 degrees, the Trip Length Shortfall increases substantially up to the maximum Fandangle of 180 degrees.

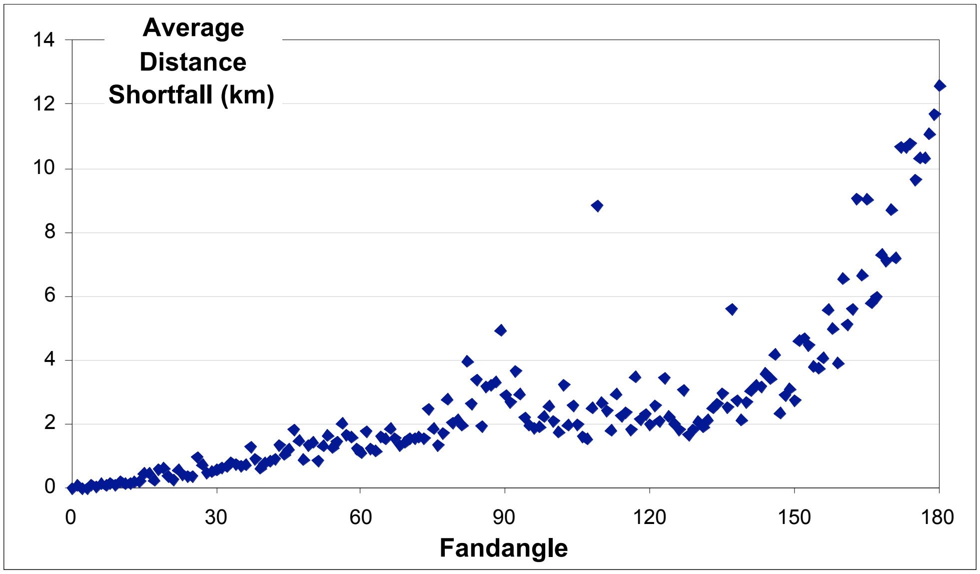

FIGURE 7 The Relationship between Fandangle and Trip Length Shortfall for SEQTS

It was noted earlier that 11% of trip stages (or activity locations) could be removed (or just not reported) and the total travel distance would not change. This finding can be extended by constructing a Lorenz Curve for Trip Length Shortfall (in the same way as was done earlier for trip stage length). The resulting curve is shown in Figure 8. It can be seen that 50% of activities could be removed (or not reported) and the total travel distance would only decrease by 3%. This finding has profound significance for travel survey design. If the main purpose of the travel surveys is to collect data for the building and calibration of network models, then there is little point spending considerable time, effort and money chasing up all the little incidental trips that people make during the day, since omitting these trips makes little difference to the total distance travelled (or at least reported).

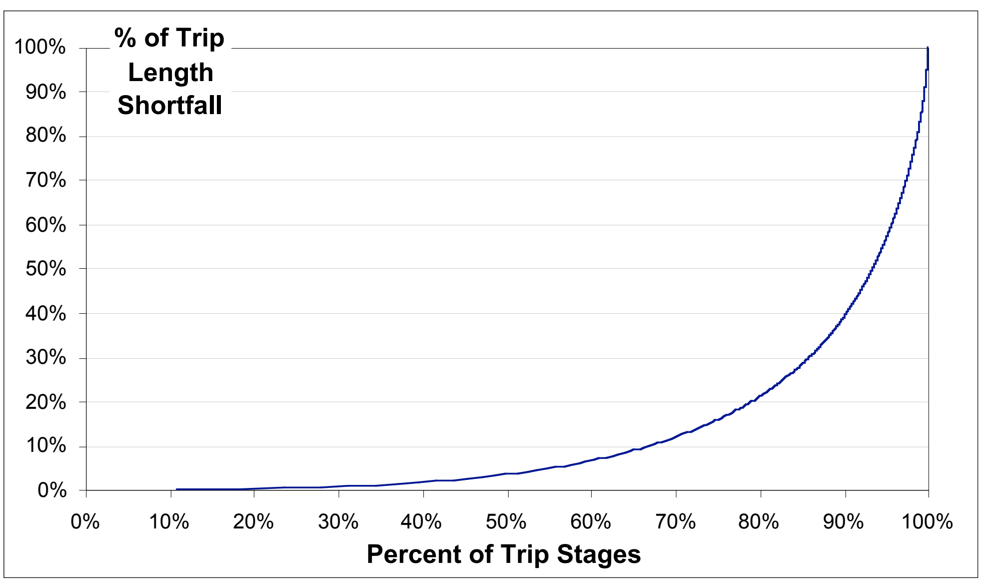

FIGURE 8 Lorenz Curve for Trip Length Shortfall for SEQTS

On the other hand, if the purpose of the surveys is to actually gain a deeper and more complete understanding of the complexity of urban travel and activity patterns, then the effort required to capture all the incidental trips may then be worth expending.

TRIP INCIDENTALITY OF VARIOUS TRIP TYPES

Assuming that some are indeed interested in a deeper understanding of incidental trips, this section of the paper makes an initial attempt to explore some of the characteristics of incidental trips, using the four measures proposed in the previous section. Paper length considerations preclude an in-depth examination, so the following must be seen as just an initial exploration upon which further work can be built, using SEQTS and other travel data sets.

Trip Stage Purpose

Each of the 41000 trip stages in the SEQTS data is classified by detailed purpose, which has been summarised into 12 main purposes as shown in Table 1. The major trip stage purposes are going home, going to work, shopping and chauffeuring (often driving kids to and from school). By comparison with the overall average, it appears that education, work and recreational trips have high Fandangles (or are highly reflexive, low totally incidental trips and high trip length shortfalls) in that a trip is made to these sites and then back to where the trip started. On the other hand, trips to home and to pickup or delivery something have low Fandangles, because having gone home you are less likely to come back to the place you have just come from (note that this only applies to trips home during the course of the travel day and does not include the 71% of trips home that occur as the last trip stage at the end of the day, when a Fandangle cannot be calculated), while pickup/delivery activities are more often done on the way to somewhere else.

TABLE 1 Measures of Trip Incidentality by Purpose of Trip Stage

Trip Stage Purpose	% of Trip Stages	% Last Trip of Day	% Reflexive Trip	Overall Average Fandangle	Average Non-reflexive Fandangle	% Totally Incidental Trip	Overall Average Shortfall
Change Mode	13%	0%	0%	80	80	26%	0.6
Accompany Someone	4%	2%	28%	127	107	8%	5.2
Shopping	9%	0%	26%	116	94	13%	3.4
Pickup/deliver Something	3%	1%	22%	113	95	11%	5.4
Chauffeuring	10%	1%	26%	120	98	7%	4.7
Education	5%	0%	48%	149	120	5%	4.9
Work-related	14%	2%	40%	138	110	6%	13.5
Go Home	30%	71%	12%	111	102	8%	3.8
Personal Business	3%	6%	33%	128	103	9%	6.1
Social	6%	5%	36%	129	100	10%	6.8
Recreational	3%	4%	50%	148	116	4%	8.7
Other Purpose	0%	7%	29%	128	106	10%	11.4
TOTAL	100%	23%	26%	119	98	11%	5.8

Trip Stage Mode

The mode used on each trip stage has been summarised as shown in Table 2. Car driver, car passenger and walk are the dominant modes for trip stages (many of the walk trip stages are for access and egress from public transport). Public transport is used for about 7% of all trip stages. Public transport modes consistently have the lowest Fandangles, since having used public transport to get somewhere (a public transport stop or station) you are very unlikely to turn around and come straight back again. You are more likely to keep heading in the same general direction to arrive at the final destination of the trip. Note that if trips, rather than trip stages, had been used in the analysis, the opposite finding would probably have been found, since public transport trips (which subsume the access and egress modes at each end) are more likely to be reflexive since public transport modes are less often used in complex chained trips.

TABLE 2 Measures of Trip Incidentality by Mode Used on Trip Stage

Trip Stage Mode	% of Trip Stages	% Last Trip	% Reflexive Trip	Overall Average Fandangle	Average Non-reflexive Fandangle	% Totally Incidental Trip	Overall Average Shortfall
Car Driver	51%	24%	29%	124	102	7%	8.4
Car Passenger	24%	29%	28%	125	103	8%	6.0
Motorcycle	0%	32%	37%	127	95	10%	11.1
Walk	17%	17%	26%	115	92	19%	0.6
Bicycle	1%	29%	45%	143	113	7%	3.5
Taxi	0%	41%	28%	132	113	5%	4.2
Train	3%	0%	0%	77	77	21%	1.0
Ferry	0%	0%	0%	76	76	19%	0.5
School Bus	1%	5%	16%	111	98	20%	4.0
Public Bus	3%	0%	0%	81	81	32%	0.4
Other	0%	27%	27%	99	69	3%	10.4
TOTAL	100%	23%	26%	119	98	11%	5.8

Trip Stage Time of Day

The degree of trip stage incidentality by time of day is shown in Table 3. The time at the end of each trip stage, or the start of the following activity, is used in Table 3.

TABLE 3 Measures of Trip Incidentality by Ending Hour of Trip Stage (start of activity)

Trip Stage Hour of Day	% of Trip Stages	% Last Trip	% Reflexive Trip	Overall Average Fandangle	Average Non-reflexive Fandangle	% Totally Incidental Trip	Overall Average Shortfall
4.00	0%	3%	58%	143	92	6%	15.3
5.00	1%	2%	45%	141	108	4%	13.6
6.00	3%	2%	36%	130	101	7%	12.9
7.00	8%	2%	26%	117	95	12%	7.1
8.00	14%	1%	32%	130	106	9%	5.7
9.00	6%	5%	28%	126	106	9%	7.1
10.00	5%	8%	24%	120	102	12%	6.9
11.00	5%	13%	20%	114	98	12%	5.7
12.00	5%	13%	21%	115	98	12%	4.2
13.00	4%	15%	21%	116	98	11%	5.1
14.00	5%	19%	24%	116	95	11%	4.4
15.00	12%	35%	16%	109	96	13%	3.4
16.00	8%	37%	20%	109	91	13%	3.9
17.00	9%	42%	23%	108	86	15%	3.7
18.00	6%	46%	35%	122	92	10%	5.6
19.00	3%	48%	46%	134	95	7%	6.8
20.00	2%	61%	31%	120	92	12%	5.9
21.00	1%	71%	28%	115	90	9%	4.7
22.00	1%	75%	27%	112	87	13%	6.8
23.00	0%	78%	21%	117	100	15%	6.2
24.00	0%	81%	0%	71	71	46%	1.1
TOTAL	100%	23%	26%	119	98	11%	5.8

It can be seen that lower Fandangles tend to occur during the peak periods, especially the evening peak, and during the afternoon. In the early morning and at night, the Fandangles appear to be at their highest.

Trip Stage Length

The degree of trip stage incidentality by the length of the trip stage (in kilometres) is shown in Table 4. It can be seen that, apart from very short trips (less than 0.5 km), the degree of incidentality appears to remain fairly constant. The very short trips have a high proportion of totally incidental trips (25%), a slightly lower proportion of reflexive trips (23%) and a lower average Fandangle (110 degrees). Clearly, the average trip length shortfall increases with the length of the trip, simply because of the scaling effect of the longer trips. Taken as a proportion of the trip stage length, the average trip length shortfall stays relatively constant as the trip stage length increases. It therefore appears that trip incidentality is not a direct function of trip stage length.

TABLE 4 Measures of Trip Incidentality by Length of Trip Stage

Trip Stage Length (kms)	% of Trip Stages	% Last Trip	% Reflexive Trip	Overall Average Fandangle	Average Non-reflexive Fandangle	% Totally Incidental Trip	Overall Average Shortfall
0	0%	15%	23%	110	89	25%	0.3
1	0%	22%	27%	120	98	10%	1.1
2	0%	23%	28%	123	101	8%	2.3
3	0%	23%	26%	121	101	8%	3.2
4	0%	21%	26%	122	101	8%	4.2
5	0%	25%	26%	122	102	8%	5.0
6	0%	23%	27%	118	96	9%	5.9
7	0%	24%	24%	118	98	7%	6.4
8	0%	22%	25%	117	97	8%	7.2
9	0%	24%	27%	120	99	6%	8.6
10	0%	25%	31%	126	103	7%	10.2
11	0%	21%	21%	108	88	14%	8.4
12	0%	25%	24%	117	97	9%	10.1
13	0%	24%	26%	123	104	7%	11.3
14	0%	25%	28%	123	102	7%	12.3
15	0%	25%	27%	128	109	8%	14.4
16	0%	25%	29%	125	103	8%	14.9
17	0%	23%	21%	113	96	10%	12.9
18	0%	28%	30%	128	105	6%	16.4
19	0%	32%	33%	133	110	5%	20.4
20	0%	30%	35%	128	100	3%	19.4
25	0%	27%	27%	123	102	8%	20.7
35	0%	34%	36%	137	113	5%	38.2
45	0%	22%	26%	118	97	6%	36.0
50	0%	37%	22%	116	98	7%	61.4
TOTAL	100%	23%	26%	119	98	11%	5.8

Activity Duration

While trip incidentality does not appear to be strongly related to trip stage length, the same cannot be said with respect to the duration of the activity following the trip stage. As shown in Table 5, activities of shorter duration tend to be much more incidental than activities of longer duration.

TABLE 5 Measures of Trip Incidentality by Duration of Following Activity

Activity Duration (hours)	% of Trip Stages	% Reflexive Trip	Overall Average Fandangle	Average Non-reflexive Fandangle	% Totally Incidental Trip	Overall Average Shortfall
0.25	29%	13%	100	87	17%	2.2
0.75	13%	21%	114	96	11%	4.5
1.25	7%	29%	126	104	7%	5.9
1.75	4%	28%	125	104	8%	6.5
2.25	3%	31%	127	104	6%	7.4
2.75	2%	31%	132	110	7%	7.7
3.25	2%	26%	128	110	7%	7.7
3.75	1%	27%	127	108	7%	8.2
4.25	1%	28%	125	105	9%	6.3
4.75	1%	28%	127	106	6%	8.3
5.25	1%	29%	131	111	10%	9.4
5.75	1%	41%	136	106	5%	7.9
6.25	1%	45%	144	115	6%	7.9
6.75	2%	47%	152	127	4%	5.7
7.25	2%	50%	150	121	4%	7.0
7.75	1%	50%	147	115	5%	10.2
8.25	1%	55%	154	123	4%	15.5
8.75	1%	60%	161	131	2%	16.4
9.25	1%	64%	163	134	2%	17.3
9.75	1%	60%	163	138	2%	20.2
10.25	1%	65%	164	134	3%	21.3
10.75	0%	67%	170	148	1%	22.7
11.25	0%	62%	162	134	2%	17.9
11.75	0%	59%	164	142	3%	25.2
12.25	0%	64%	172	158	0%	17.4
TOTAL	100%	26%	119	98	11%	5.8

This is highlighted in Figure 9, where the proportion of totally incidental trips is shown as a function of activity duration.

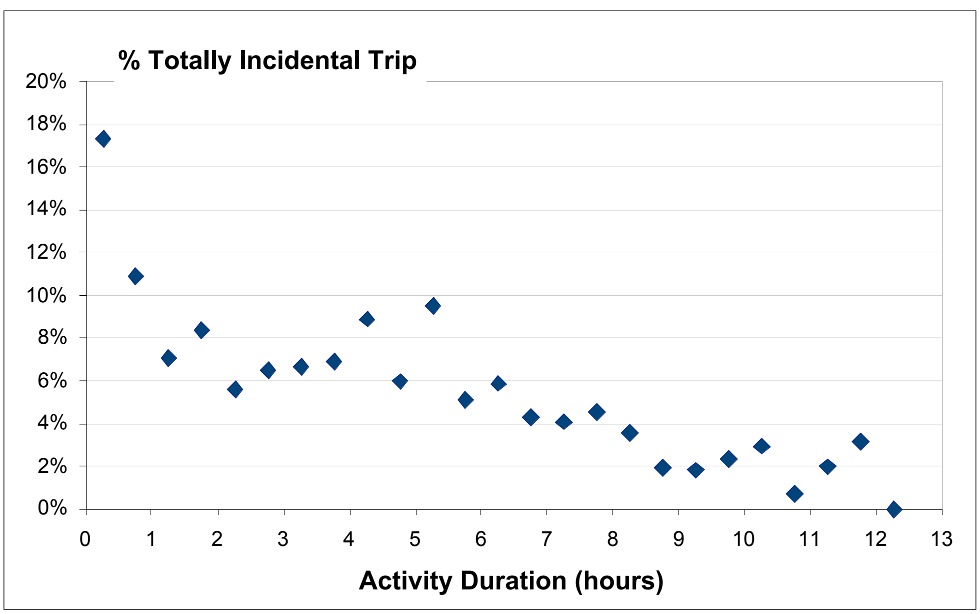

FIGURE 9 Totally Incidental Trips as a function of Activity Duration for SEQTS

It can be seen that 17% of very short duration activities (less than 30 minutes) are totally incidental, in that they could be removed without any effect on the total distance travelled, while 11% of activities between 30 and 60 minutes are totally incidental. From there on, the proportion of totally incidental trips falls fairly linearly. Importantly, many of the Starbucks trips would be in the lowest activity duration category.

CONCLUSIONS

This paper has examined the concept of trip incidentality, where trip incidentality is defined in terms of the effect on total daily travel distance of removing (or not recording) specific activities from the daily set of activities. The paper has proposed four measures of trip incidentality, and has applied these measures to a travel survey data set (SEQTS) collected in Brisbane in 2003-2004. Several findings concerning the measurement of daily travel are of importance. While trip rates have traditionally been used to measure daily travel, it has been shown that 50% of trip stages could be removed from the data set and only 20% of travel time, 8% of trip stage distance and 3% of trip chain distance would be lost. These findings question the robustness of using trip rates as the primary means of measuring daily travel patterns, especially when the data is to be used in the development of transport network models.

The paper further explores the extent of trip incidentality as a function of several trip and activity characteristics. It has been found that activities are less likely to be incidental if they are for work, education or recreation purposes, are more likely to be incidental if they are at the end of a public transport trip stage or are during peak periods. They appear unaffected by the length of the trip stage preceding the activity, but are highly influenced by the duration of the activity itself, with shorter duration activities being much more likely to be incidental.

In the context of the Starbucks Effect, such "coffee-stop" activities are short duration and during the peak are hence, based on the above findings, are likely to be incidental. Removal of such activities is unlikely to greatly affect daily travel distance. Conversely, the insertion of such activities is unlikely to greatly increase daily travel distance. Therefore, one can conclude that the Washington Post comment that "Researchers say the craving for gourmet coffee may add mileage to the morning rush and also complicate efforts to reduce traffic, save fuel, and reduce air pollution" is somewhat of an exaggeration.

REFERENCES

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