

Variations in Personal Travel Habits by Day of Week

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• ORIGIN-DESTINATION studies have demonstrated that travel in an urban area is remarkably regular in nature. It is, indeed, this particular phenomenon that permits a confident prediction of future tripmaking. This does not mean, however, that tripmaking is exactly orderly day by day but, rather, that travel is highly repetitive and, being so, forms a consistent—hence, predictable—pattern over a period of several weeks or months.

Certain trip types, such as trips from home to work or to school and return, are very regular on a daily basis through the week. These types of trips are a strong influence in stabilizing the total number of trips occurring day to day. Other types, however, such as trips for shopping, social-recreation, and personal business reasons, are apt to be more widely and unevenly spaced through the week, and therefore, are chiefly responsible for the day-to-day fluctuations that occur in tripmaking volumes.

This paper explores some of the weekday tripmaking variations that were revealed in the Pittsburgh Area Transportation Study's 1958 home interview survey. Chiefly, attention is given to the day-to-day variations in tripmaking for the whole study area, with a separate examination of daily variations in travel to the Golden Triangle, Pittsburgh's central business district.

SAMPLE ADJUSTMENT

Evenness in Sampling a Factor

Before measuring daily tripmaking variations, it was necessary to adjust for the differences by day of the week in the number of interview schedules used in deriving the original trip factors. These factors were based on 16,247 completed interviews plus 1,683 schedules in which trips were possible but, for various reasons, interviews were not consummated. The method of correction was to find each day's percentage variation from the daily average number of interviews and to apply that percentage to all trip tabulations for each day. For example, with the 5-day average number of interviews equal to 100.0, Monday total interviews amounted to 107.19465 times that average, that is, slightly over 7 percent higher. Applying this factor to Monday's total travel of 2,268,080 person trips adjusts the number of trips to 2,115,852 person trips.

Perhaps a superior method of adjustment could have been achieved by using more complex factors based on some of the unexpanded household characteristics, such as auto ownership, persons per dwelling place, or licensed drivers per dwelling place (Table 1). Inasmuch as this information was not uniformly available for the noninterviews, no attempt was made to include these variables in the correction method. It is noteworthy, nevertheless, that households interviewed on Tuesday have somewhat lower ratios of persons, autos owned, and licensed drivers per dwelling place and have the highest percentage of no autos per dwelling place (Table 1). This probably had some effect on the low trip volumes reported for Tuesday.

Sampling Variability

Given an equalized number of interviews per day, the effect of sampling variability should be relatively slight in this examination since it deals with two large universes.

TABLE 1
COMPARISON OF SELECTED HOUSEHOLD CHARACTERISTICS
BY TRAVEL DAY OF WEEK

Day	Completed Interviews	Per Dwelling Place					
		Persons	Autos	Licensed Drivers	Autos Owned		
					0 (%)	1 (%)	2 or More (%)
Monday	3,473	3.33	0.89	1.3	26.7	59.1	14.2
Tuesday	2,958	3.23	0.84	1.2	29.3	57.9	12.7
Wednesday	3,296	3.28	0.87	1.3	28.4	57.9	13.7
Thursday	3,284	3.22	0.85	1.2	28.9	58.3	12.8
Friday	3,236	3.22	0.89	1.3	26.6	59.4	14.0

In the first case, this report deals with data for the entire study area based on 17,930 samples (an average of 3,586 samples per day of week); and in the second, it deals with the most concentrated single trip generation area (about 1,065 samples per day).

AGGREGATE INTERNAL TRIP VOLUMES

Daily Variations by Mode of Travel

After equalization, total tripmaking is characterized by one comparatively light day of travel, one very heavy day, and three remaining days of the week with fairly equal amounts of travel.

Figure 1 shows that Tuesday travel (by all modes) falls 7 percent short of the 5-day average of about 2,200,000 person trips in the study area; Friday tripmaking soars to nearly 12 percent above average. Monday, Wednesday, and Thursday trip volumes are about 3 percent, 1 percent, and 0.5 percent below average, respectively.

The pattern of auto driver trips closely resembles that of total travel—not unnaturally since auto driver trips constitute a little more than half of all trips each day. Driver volumes are fairly steady Monday through Thursday but rise very sharply on Friday. The drop shown for all modes on Tuesday is less pronounced in driver trips than for other modes.

Passenger tripmaking forms a pattern similar to that of auto driver tripmaking but with an accentuated profile. (This includes auto passengers, 97.4 percent; taxi passengers, 2.3 percent; and truck passengers, 0.3 percent.) Passenger travel is well below average on Monday, falls off further on Tuesday to nearly 13 percent below average, approaches the average on Wednesday and on Thursday, then climbs on Friday to about 23 percent above the daily average of passengers.

Mass transit ridership is the most regular of all modes. Monday is high for the week at 3.5 percent above average; the low day, Tuesday, is 6 percent below average. Unlike driver and passenger travel, transit trips drop below average on Friday.

To summarize briefly, Monday is an above average day for mass transit travel but is below average for both driver and passenger tripmaking. The low total trip volume on Tuesday is the result of decreases in travel in all modes. Wednesday and Thursday appear to be average days because tripmaking on those days approximately equals the daily average within each mode of travel. The very substantial gain in total trips on Friday represents large increases in driver and in passenger volumes only, since mass transit trips fall below average on that day.

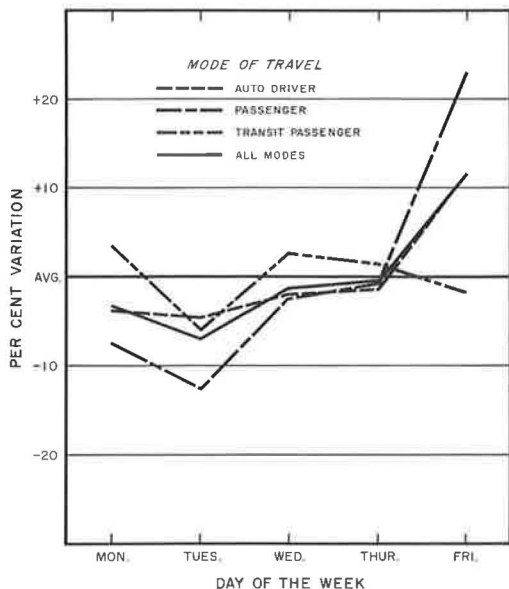


Figure 1. Daily variation of total internal person trips by mode of travel.

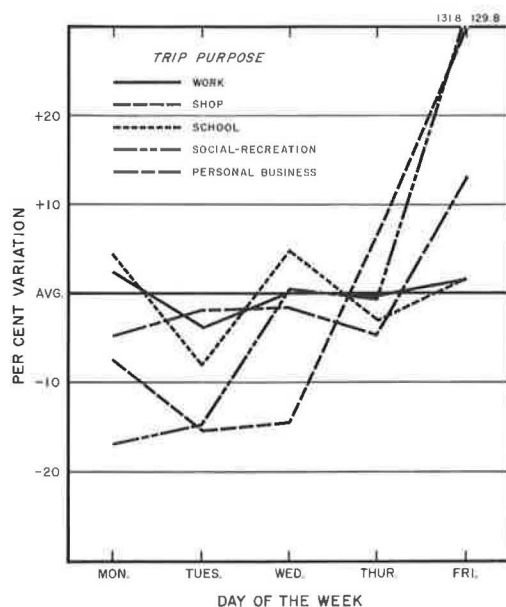


Figure 2. Daily variation of total internal person trips by trip purpose.

Daily Variation by Trip Purpose

Figure 2 shows that work trips remain within 4 percent of the average by day of week and are the most regular of all trip types. School trips are the second most steady, varying less than 8 percent from average. Tripmaking for personal business reasons stays within 5 percent of average until Friday when they rise to 13 percent above average. Shopping trips are well below average until Thursday and Friday when extremely large gains are made. Social-recreation trip volumes are very low until Wednesday when they reach their 5-day average, remain average on Thursday, and rise steeply on Friday.

When the effect of variations in trip purposes on total daily volumes is considered, the above average number of trips to work and to school on Monday are more than balanced by below average trips for shopping, social-recreation, and personal business. The low total volumes for Tuesday are the result of a decrease in activity in each trip category except personal business. While below average amounts of shopping and social-recreational trips on Tuesday are not unexpected, the substantial decreases in work trips and in trips to school are difficult to rationalize. Wednesday tripmaking is about average in each trip purpose category except trips for shopping and school. Light shopping offsets moderate gains in school trips on Wednesday; above average shopping volumes on Thursday approximately equal the decreases in school and personal business trips so that Thursday total travel about equals the 5-day average. Very large increases in trips for shopping, social-recreation, and personal business are responsible for nearly all of the gain in total trips shown for Friday.

Reviewing briefly, the major differences in total trip volumes by day of the week are caused by an uneven trip distribution during the week within shopping, social-recreational, and personal business categories. Heavier shopping on Thursday and Friday probably is a combination of the need for groceries and sundries for the weekend and the fact that these days are traditional paydays. The influence of paydays on Friday trips for personal business may be even greater because there are checks to cash and bills to pay. Many of these trips are probably parts of combinations of shopping and personal business trips. The larger volumes of social-recreational trips on Friday are expected.

GOLDEN TRIANGLE TRIPMAKING

Daily Variation by Mode of Travel

Just as there is a high and a low day of travel for the entire study area, so it is with Golden Triangle (GT) tripmaking (Fig. 3). Unlike the total study area, however, the GT tripmaking peak occurs on Monday when volumes are nearly 11 percent above the 5-day average of about 133,000 person trips. Like the total study area, Tuesday is the lightest travel day since volumes are almost 9 percent below average. Also, like the total study area, Wednesday and Thursday travel approximates the 5-day average. Reversing the condition found on Monday when total study travel is below average and GT trip volumes reach a peak, Friday travel to the GT falls slightly short of average, whereas total study tripmaking soars far above average.

Driver trips average a little more than one-fourth of all GT trips. They are most numerous on Monday and Friday when they are above average by 7 percent and 12 percent, respectively. Tuesday trips drop to 12 percent below average (low for the week); Wednesday shows a gain toward average by about 6 percent; Thursday driver trips are about 1 percent below average.

Passenger trips represent, on the average, about 15 percent of total GT trips. They are well above average on Monday (about 6.5%) and on Thursday (about 10%). Tuesday volumes are about average. Wednesday passenger trips fall nearly 13 percent below average, while Friday is about 4.5 percent under average.

About 57 percent of all internal person trips to the GT are made by mass transit, including trips made by railroad. The peak for this mode occurs on Monday when mass transit trips are nearly 14 percent higher than the daily average. The high Monday volumes are due largely to the impact of evening openings in the majority of GT retail stores. Tuesday and Friday mass transit volumes both are well below average (10% and 7.5%, respectively). Wednesday travel is 3.5 percent above average and Thursday mass transit trips equal the daily average.

From the standpoint of traffic congestion, it is probably fortunate that peaks for driver trips and mass transit ridership to the GT do not occur on the same day of the week. However, both driver and transit volumes are very heavy on Monday (Fig. 3). The full effect of this condition is reduced, however, because tripmaking is spread out more evenly throughout the day. This distribution is also a result of evening openings of retail stores, the effect of which is indicated further by examination of trip purposes.

Daily Variations by Trip Purpose

High tripmaking volumes to the GT on Monday are caused largely by far above average shopping activity, induced by most retail stores remaining open in the evening; but substantially above average trips for work add considerable weight to total trips, as do, to a lesser degree, trips for personal business (Fig. 4). The significant drop in shopping and work trips is, conversely, the principal reason for the deep decline in total GT trips on Tuesday. Wednesday travel shows small to moderate increases in all trip categories. Shopping trips show a large gain on Thursday because the stores remain open in the evening again. Social-recreational trips also start to increase, but most of this gain is offset by a sizable loss in personal business trips. The spec-

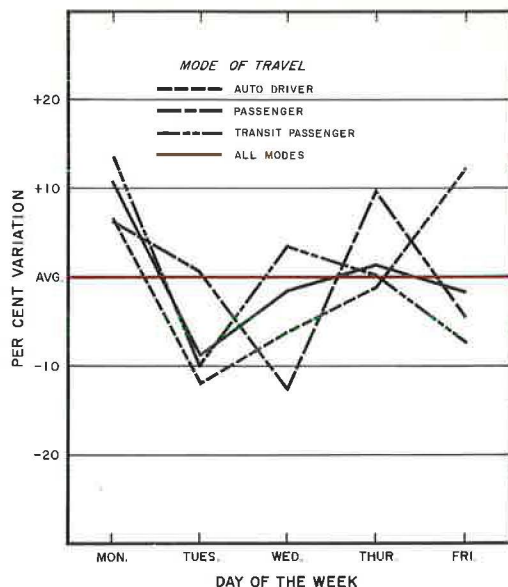


Figure 3. Daily variation of Golden Triangle person trips by mode of travel.

TABLE 2
PERCENTAGE DISTRIBUTION OF GOLDEN TRIANGLE TRIPS
BY DESTINATION LAND USE FOR EACH TRAVEL DAY

Day	Land Use									Total
	Retail			Services				Public Buildings	All Other	
	Department Stores	Other	Total	Central Offices	Personal Services	Other	Total			
Monday	30.6	10.7	41.3	20.4	13.7	10.1	44.2	6.5	8.0	100.0
Tuesday	24.6	10.5	35.1	25.3	12.1	8.5	45.9	8.1	10.9	100.0
Wednesday	23.6	8.8	32.4	23.5	16.4	9.7	49.6	8.3	9.7	100.0
Thursday	27.9	10.5	38.4	22.4	14.2	9.5	46.1	7.8	7.7	100.0
Friday	19.5	11.2	30.7	22.7	14.3	12.2	49.2	7.8	12.3	100.0

tacular increase in trips on Friday in the lightly weighted social-recreational category is balanced by very deep losses in shopping trips and below average volumes of personal business trips. Work trips remain steady on Friday.

Daily Variation by Land Use at Destination

Establishments that deal in retail goods and services attract about four-fifths, or more, of all person trips to the GT each day (Table 2). Public buildings are the only other major trip generators, drawing an average of about 8 percent. Trip percentages to all other land uses, such as wholesalers, manufacturers, utilities, residences, and parks are inconsequential individually.

As could be expected, retail stores attract their largest percentages on Monday and Thursday. This is due mostly to the influence of department store trips since the trip percentages for other retail outlets remain fairly steady throughout the week. The percentage of trips to department stores drops sharply on Friday.

Service establishments draw their highest percentages on Wednesday and Friday. Actually, the trip volumes to these places are very steady, and the variations are the result of lighter or heavier trip weighting in other land uses. This is particularly true of trip percentages to central offices, which are mostly work trips and very regular in volumes. A greater proportion of trips to personal service establishments consisting of financial, legal, and medical offices occurs in the latter part of the week. The somewhat higher percentage on Friday for trips to other service places is understandable since these include theatres, nightclubs, and other indoor recreational places. Day-to-day percentages of trips to public buildings are quite regular except on Monday. The lower percentage for Monday is largely the result of heavier weighting by other land uses.

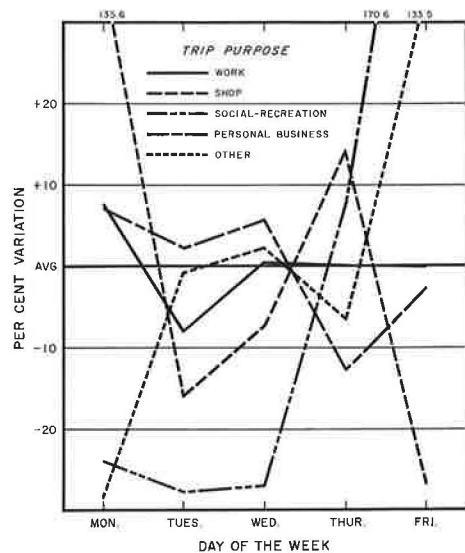


Figure 4. Daily variation of Golden Triangle internal person trips by trip purpose.

TABLE 3
 PERCENTAGE ACCUMULATION OF GOLDEN TRIANGLE TRIPS
 BY HOUR OF ARRIVAL FOR EACH DAY OF THE WEEK

Day	Accumulation (hour ending)												
	AM			PM									
	9	10	11	12	1	2	3	4	5	6	7	8	9
Monday	39.9	52.2	60.4	66.7	71.3	75.6	79.5	82.4	85.4	89.0	93.4	97.2	98.7
Tuesday	41.9	56.6	66.6	73.6	77.3	82.9	86.9	89.5	92.0	94.0	95.9	97.6	98.6
Wednesday	45.4	59.7	69.3	74.4	77.6	84.2	87.6	91.3	93.4	95.3	96.7	97.7	98.9
Thursday	40.2	53.7	62.1	68.7	72.0	76.9	81.0	85.8	88.6	90.9	93.7	97.3	98.8
Friday	30.9	57.3	65.1	70.7	73.9	77.5	81.5	84.2	86.1	89.8	91.5	94.1	96.8

Daily Variations by Hour of Arrival

Table 3 shows the percentage distribution of trips to the GT by day of the week. The hourly accumulation of trips to the GT by day of the week is generally fairly regular because about 60 percent of these trips each weekday are trips to work. These trips are reflected in the morning peak-hour accumulation.

The effect of evening shopping can be observed in the higher percentages that occur in the late afternoon and early evening hours on Monday and Thursday. Similarly, increased social-recreation on Friday appears in the higher percentages in late evening hours on that day. Curiously, Friday morning accumulation is considerably slower than on other days at 9:00 AM but catches up by 10:00 AM. Inasmuch as nearly all trip-makers who arrive in the GT before 9:00 AM are going to work, many of them must have later starting times on Friday or are just plain late. If the latter is the case, the need for timeclocks, tougher supervisors, or increased personnel turnover may be indicated.

CONCLUSIONS

It appears desirable in future O-D studies to plan more carefully to obtain an equal number of samples by day of the week.

The presence of holidays within the interviewing period can result in wide differences in the number of samples scheduled by day of the week. The number of interviews pertinent to the expansion factor may vary significantly by day of the week. If no attempt were made to equalize the number of interviews per day or, at least, to factor for any inequality, serious distortions could result if large differences were present in both tripmaking volumes and number of interviews by day of the week. These differences probably can be reduced by finding, near the end of the interviewing period, the number of completed interviews by day and by adjusting the travel dates of the remaining schedules with an eye toward equalization.

In the Pittsburgh study, rather large differences in trip volumes were found between the peak day and the average day of travel. In the whole study the difference amounted to about 250,000 person trips, or about 12 percent, whereas in the Golden Triangle the difference was about 13,000 trips, or 11 percent. Awareness of the extent of these differences is vital, of course, in transportation planning.