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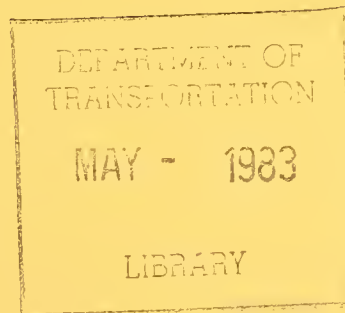
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**Urban Mass
Transportation
Administration**

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Atlanta Integrated Fare Collection Demonstration

**Final Report
September 1982**



**UMTA/TSC Project Evaluation Series
Service and Management Demonstrations Program**

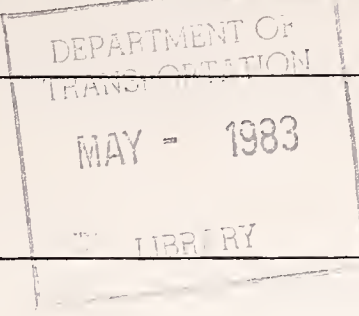
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PREFACE

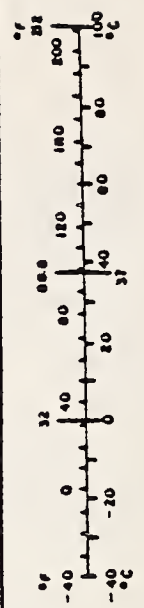
This evaluation of the Atlanta Integrated Fare Collection Demonstration was prepared in the Boston, Massachusetts office of Charles River Associates Incorporated (CRA) for the Transportation Systems Center (TSC) of the U.S. Department of Transportation (DOT) under Contract Number DOT-TSC-1757. The evaluation was undertaken as part of the Service and Methods Demonstration (SMD) Program sponsored by the Urban Mass Transportation Administration (UMTA). Thomas E. Parody served as CRA's evaluation manager and principal investigator. Larry Doxsey of TSC served as technical advisor and monitor for the evaluation and provided many useful comments throughout the period of the demonstration. Marvin Futrell, and more recently, Vince Milione were the UMTA project managers.

Many individuals contributed to the development of this evaluation report. Within CRA, Thomas E. Parody directed the evaluation and was the principal author of this report. Kim Honetschlager performed the computer tabulation work. Other CRA contributors included Janet Fearon and Robert Scheier, publications, and Sharon Ayres and Susan Simons, graphic artists. The efforts of all of these individuals were supervised by Daniel Brand, CRA's Officer-in-Charge of work conducted for the SMD program, who provided overall guidance and many helpful suggestions.

Although CRA accepts full responsibility for the information and conclusions presented in this report, the evaluation would not have been possible without the cooperation and assistance of John Bates and Norris Anderson of the Metropolitan Atlanta Rapid Transit Authority, who provided much of the data from the site and Bert Arrillaga of UMTA, who was involved in setting up the demonstration.

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures				Approximate Conversions from Metric Measures			
Symbol	When You Know	Multiply by	To Find	Symbol	When You Know	Multiply by	To Find
LENGTH							
in	inches	2.5	centimeters	mm	millimeters	0.04	inches
ft	feet	30	centimeters	cm	centimeters	0.4	inches
yd	yards	0.9	meters	m	meters	3.3	feet
mi	miles	1.6	kilometers	km	kilometers	0.6	miles
AREA							
in ²	square inches	6.5	square centimeters	cm ²	square centimeters	0.16	square inches
ft ²	square feet	0.09	square meters	m ²	square meters	1.2	square yards
yd ²	square yards	0.8	square meters	km ²	square kilometers	0.4	square miles
mi ²	square miles	2.6	square kilometers	ha	hectares (10,000 m ²)	2.6	acres
MASS (weight)							
oz	ounce	28	grams	g	grams	0.035	ounce
lb	pounds (2000 lb)	0.45	kilograms	kg	kilograms	2.2	pounds
		0.9	tonnes	t	tonnes (1000 kg)	1.1	short tons
VOLUME							
teaspoon	teaspoons	5	milliliters	ml	milliliters	0.03	fluid ounces
tablespoon	tablespoons	15	milliliters	ml	liters	2.1	pints
fluid ounce	fluid ounces	30	milliliters	ml	liters	1.06	quarts
cup	cups	0.24	liters	l	liters	0.26	gallons
pint	pints	0.47	liters	l	cubic meters	36	cubic feet
quart	quarts	0.95	liters	l	cubic meters	1.3	cubic yards
gallon	gallons	3.8	liters	m ³			
cubic foot	cubic feet	0.03	cubic meters	m ³			
yd ³	cubic yards	0.76	cubic meters	m ³			
TEMPERATURE (exact)							
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature



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EXECUTIVE SUMMARY

INTRODUCTION

In 1979, the Metropolitan Atlanta Rapid Transit Authority (MARTA) received a demonstration grant from the Service and Methods Demonstration (SMD) Program of the Urban Mass Transportation Administration (UMTA) for the purpose of investigating a number of issues associated with the introduction and sale to the general public of a monthly, unlimited-use transit pass. One of the main objectives of the Atlanta Integrated Fare Collection Demonstration was to evaluate the extent to which a transit pass serves to act as a fare and transit integration instrument for transit users who make intramodal (i.e., bus to bus) and/or intermodal (i.e., bus to rail) transfers. In this context, intramodal/intermodal fare integration refers to establishing consistent fare and transfer policies for a trip of a particular length rather than being based on the mode or combination of modes used to make a trip.

In addition to the issue of transit integration, this evaluation also examines four other major aspects of the Atlanta demonstration project -- socioeconomic and transit ridership characteristics of pass buyers; ridership and revenue consequences of a systemwide fare increase; bus-rail integration enhancements due to barrier-free station design; and impacts associated with introducing rail transit service.

DEMONSTRATION OVERVIEW

The cornerstone of the Atlanta demonstration was the introduction of TransCard on March 1, 1979, as a means of minimizing the impact of a simultaneous 67 percent increase in the flat fare charged in Fulton and DeKalb Counties. The monthly TransCard was priced at \$10.00, representing a breakeven level of 20 round trips per month. The pass, whose price remained constant throughout the course of this demonstration, was valid for unlimited rides during a given month by one individual (i.e., the pass is not transferable). Since MARTA has a universal system of free transfers between connecting bus lines (and, after it opened in July 1979, to the rail system) transit users who purchase a pass and must make a transfer are not required to obtain a transfer slip from the driver of the initial bus boarded nor need they carry the exact boarding fare. The latter benefit is associated with all prepayment instruments (which include passes, tickets, etc.) while the former benefit is applicable only to transit systems that allow free or reduced-fare transfers.

A chronology of the various demonstration phases and data collection activities associated with the Atlanta project is shown in Table S-1. The

TABLE S-1. CHRONOLOGY OF
DEMONSTRATION ACTIONS AND EVENTS

Date	Activity
1979: March 1	Fares increase from \$0.15 to \$0.25; TransCard introduced
April	Demonstration grant signed
May 10-31	Before on-board bus survey implemented
July 1	East Rail Line revenue service begins (no feeder bus or weekend service)
September 8	Weekend rail service on East Line starts
October 13	East Line feeder bus reconfiguration
November 12	Westbound rail (pre-test) survey administered
December 22	West Rail Line Opens (no feeder bus service)
1980: May 5-30	After on-board bus and rail surveys implemented
June	West Line feeder bus reconfiguration
July 26	Fares increased from \$0.25 to \$0.50; \$4 weekly pass introduced; TransCard increased from \$10 to \$17

first demonstration phase began on March 1, 1979 when TransCard was introduced and basic transit fares were increased from \$0.15 to \$0.25. To obtain data on changes in individual transit travel behavior and characteristics of pass purchasers a (personally administered) before on-board bus survey was conducted during the period May 10-31, 1979. The next major demonstration phase was the opening of the East Rail Line on July 1, 1979 and institution of feeder buses which occurred on October 13, 1979. While the West Rail Line opened on December 22, 1979, coordinated feeder buses on this segment of the rail system did not begin until June 1980. The "after" on-board bus and rail surveys were implemented in May 1980 and provided data used to evaluate the intermodal integration characteristics of TransCard, both with and without a system of complementary feeder buses, and the user-perceived enhancement of a barrier-free rail transit station.

SUMMARY OF DEMONSTRATION IMPACTS AND FINDINGS

The following sections summarize the major demonstration impacts and findings that have been documented during the course of this evaluation. The results are presented according to the five major issue categories that pertain to the Atlanta demonstration.

PASS IMPLEMENTATION IMPACTS

Transit passes that are made available to the general public (in contrast to passes only sold through employers) are almost exclusively purchased by frequent transit users (i.e., by individuals who use transit at least as much as the implied "breakeven" trip rate). Therefore, the socioeconomic characteristics of pass purchasers tend to reflect the characteristics normally associated with frequent transit users. Thus, pass purchasers tend to include more females, more minorities, older individuals, and individuals that are more likely to be captive to transit. On a univariate level, TransCard individuals have lower incomes than cash-paying transit riders. However, if other factors are controlled for (e.g., transit trip frequency, and number of transfers required), income was not found to be a significant description of a TransCard purchaser.

The data on transit trip frequency reveals a strong relationship between the number of transit trips taken per week to or from work and whether an individual purchases a TransCard. There is a similar but less pronounced relationship for nonwork bus trips per week. In all, approximately 95 percent of the pass buyers reported making the same or more than the required number of trips to breakeven. It should be noted, however, that a relatively large number of frequent transit users continue to pay with cash fares.

On average, individuals purchasing a pass increased the number of bus trips taken per week for work by 0.6 and by a larger 1.1 for nonwork trip purposes. Somewhat ironically, those individuals who were very frequent users of the transit system before the pass was introduced made fewer new trips by transit compared to the more marginal transit users who also purchased a pass. Also surprising was the fact that pass penetration rates increase very little as transit trip frequency increases beyond the breakeven point. Some evidence exists to indicate that the lump sum, front-end cost of the pass prohibits certain low income transit riders from buying the pass.

Consistent with the findings above on how often a transit pass is used each month, the majority of individuals said that they purchased a pass to "save money." While "convenience" was the second most frequent response, few pass holders reportedly made fewer than the breakeven number of trips just for the convenience of using a pass. Only individuals with incomes exceeding \$25,000 cited "convenience" factors more often than "saving money" for why they purchased a monthly transit pass.

FARE INCREASE EFFECTS

The 66.7 percent increase in transit fares resulted in a net increase in transit revenues to MARTA of approximately 58 percent. (Actual revenues in the months following the fare increase were up by a slightly larger amount due to a fairly sharp increase in the price of gasoline.) A disproportionately larger share of the increased revenues, however, were paid by cash users, and conversely a smaller share was paid by TransCard users. Consequently, many of the TransCard buyers were shielded from the full impact of the fare increase since the pass price represents an upper limit on the monthly cost of using transit. There still existed, however, many cash-paying transit users who make more than the breakeven number of trips, but who did not switch to the pass in order to lessen the financial impact of the fare increase.

Cash-paying individuals who continued to use transit after the fare increase had, on average, a nearly zero change in transit trip frequency. But, since the increase in fares collected from cash users did not match the percentage increase in base fares, it was estimated that the fare increase resulted in approximately 3,000 individuals making a complete switch in modes. This represented a decline of approximately 27,500 linked trips per week made on the transit system (i.e., about 2.6 percent). This loss in trips by former cash users was offset by the increase in transit trips made by individuals who purchased a TransCard.

INTRAMODAL AND INTERMODAL INTEGRATION

Individuals who must make one or more bus-to-bus transfers to complete their trip are proportionately more likely to be TransCard purchasers, all else being equal. This finding supports the hypothesis that transit passes are relatively more likely to be used as an instrument for intramodal fare integration. (Relatively is used here since many transit users, including those who transfer, continue to pay with cash fares.)

With regard to intermodal integration, an analysis of the data indicates that providing a coordinated system of feeder bus service to rail stations has the largest impact on intermodal integration, followed by a much smaller but still positive effect due to TransCard. Although small in absolute terms, TransCard's effect on bus-to-rail integration appears to be slightly larger than its effect on bus-to-bus integration. These findings are likely to be very dependent on the particular network and scheduling conditions found in Atlanta and therefore may not be directly transferable to other areas.

BARRIER-FREE STATION DESIGN

One aspect of the bus/rail integration issue was whether a "barrier-free" rail transit station would enhance rail-bus integration compared to stations with "barriers" (i.e., going through a turnstyle using a TransCard or a transfer "card" obtained from a bus driver). To evaluate this concern, individuals responding to the "after" on-board bus and rail surveys who transfer between bus and rail were asked to rate the convenience of the transfer. Based on an analysis of these convenience ratings, there was no significant difference between the convenience ratings of individuals using the barrier-free Avondale station and all other stations on the East rail line. This result was observed for both cash and TransCard users and for individuals surveyed either on board the bus or rail system. Confirming the significant impact of a coordinated system of feeder buses, convenience ratings for cash users were statistically better for individuals transferring on the (coordinated) East line compared to the (uncoordinated) West line.

RAIL TRANSIT TRIP GENERATION AND DIVERSION

Data from both the rail pre-test and the after on-board rail surveys indicate that about 60 to 70 percent of the rail riders previously used a MARTA bus to make the trip that was now being made on the rail system. About 30 percent of the rail trips were diverted from other (nontransit) modes, while about 8 percent represented newly generated trips. Of the trips diverted from nontransit modes, the vast majority (90 percent) represented single auto drivers.

Of the rail trips that were previously made by bus, bus continued to be used by 68 percent of the respondents as an access mode to the rail station. However, the remaining 32 percent of the trips formerly taken by bus are now being made by a nontransit mode to reach the rail station. In particular, about 45 percent of these rail access trips are now made by auto drivers, 9 percent by auto passengers, and 46 percent by walk and other modes.

1. DEMONSTRATION PROJECT OVERVIEW

1.1 PROJECT SUMMARY

The main purpose of the Atlanta Integrated Fare Collection Demonstration Project was to evaluate the extent to which the introduction of a monthly, unlimited-use transit pass serves to act as a fare and transit integration instrument for intramodal (i.e., bus to bus) and intermodal (i.e., bus to rail) transit users. In this instance, intramodal/intermodal fare integration refers to establishing consistent fares and transfer policies based on the transit trip being made without being dependent on the mode or combination of modes used to make the trip. The more general term, "transit integration" refers to the broader operation of an urban transit system in which all modes (and different transportation agencies) complement each other, and in effect, operate as a unified system. Besides charging consistent fares across modes this concept also implies the maximum coordination of schedules and physical facilities to permit quick and easy transfers either between two of the same or different modes.*

The cornerstone of the present demonstration was the introduction on March 1, 1979 by the Metropolitan Atlanta Rapid Transit Authority (MARTA) of TransCard, a monthly pass valid for unlimited rides during a given month by one individual (i.e., the pass is not transferable). Since MARTA has a universal system of free transfers between connecting bus lines (and to the rail system) transit users who purchase a pass and must make a transfer are not required to obtain a transfer slip from the driver of the initial bus boarded nor need they carry the exact boarding fare. The latter benefit is associated with all prepayment instruments (which include passes, tickets, etc.) while the former benefit is applicable only to transit systems that allow free or reduced fare transfers.

On July 1, 1979 MARTA began rail transit revenue service for the first time on the East Line from Avondale to the Georgia State station, a distance of 6.7 miles. The second component of the demonstration evaluates the intermodal fare integration effects that result because TransCard users can transfer at no additional cost and without the need of a "transfer card" between the bus and rail line. The operational integration effects of serving the rail system with a coordinated system of feeder bus lines is also investigated.

*INTERPLAN Corporation, Integration of Transit Systems, prepared for the Urban Mass Transportation Administration, (Santa Barbara, CA.: October 1973).

In addition to the intramodal and intermodal transit fare integration components of the demonstration (i.e., the introduction of TransCard and the operation of a coordinated bus-rail service, respectively), two other aspects of the Atlanta system are evaluated. The first involves separating out the ridership and revenue consequences of a fare increase from the effects of the concurrent introduction of TransCard that also occurred on March 1, 1979. On this date, MARTA raised the flat fare charged in Fulton and DeKalb counties from \$.15 to \$.25. (Fares outside of these two counties were also increased but were higher to begin with to compensate for the fact that a 1 percent sales and use tax for operating MARTA is not levied.) TransCards were priced at \$10 reflecting a breakeven usage rate of 20 round trips per month.* The impact that TransCards have on offsetting the effect of the fare increase on heavy users of the system is also included in this analysis.

The second additional component of the demonstration that was analyzed involves the extent to which a barrier free bus-rail transfer station promotes intermodal transit integration and thus increased transit usage. Avondale station on the MARTA East Line, and Hightower Station on the West Line, were intentionally designed to allow cash-paying passengers departing from feeder buses to enter into the rail station without the need for a transfer slip or similar device. Of course, TransCard users would not need to obtain a transfer slip to enter the rail station as the TransCard itself activates the turnstyle.

1.2 PROJECT INNOVATIONS AND SMD OBJECTIVES

The primary innovation of the Atlanta demonstration concerns the intramodal/intermodal fare and transit integration aspects of introducing a monthly transit pass and, after opening the rail system, providing rail feeder bus service. The principal evaluation issue concerns the extent to which transfers between two buses or between the bus and rail modes are facilitated. This can be accomplished by the availability of a "common" pass that allows one to complete a transfer without the need for cash or a separate transfer "card" which otherwise would be obtained on the bus portion of the trip.**

*Subsequent to this evaluation, the pass price was increased to \$17.00 in July 1980 when transit fares were increased from \$.25 to \$.50 and again to \$21.00 in July 1981 when fares were increased to \$.60.

**"Card" is used here since individuals transferring from bus to rail receive an encoded pass or fare card (identical in shape to the monthly TransCard) from the bus driver that when inserted into the faregate at the rail station will activate the turnstyle. Unlike TransCard, of course, the transfer card is not returned to the user.

While the Atlanta demonstration touches on a number of issues directly related to transit operations, the principal SMD objective concerns increasing transit productivity by implementing a monthly transit pass that minimizes the disutility associated with making either intramodal or intermodal transfers. An increase in transit riders and thus productivity may occur if individuals switch from other modes to transit, or (if they already use transit) by increasing their transit trip frequency. Unlike the introduction of some transit incentives, however (e.g., those directed at encouraging work trip commuters to use transit, which result in increasing the number of peak-hour transit trips), the introduction of a monthly transit pass available to all transit riders tends to be purchased by regular transit users who, if they make additional trips at all, tend to do so during the offpeak hours. Typically, excess capacity exists for trips made during this time of the day. Since additional equipment is usually not needed for the generated trips taken in the offpeak period, total transit productivity may be increased.

1.3 DEMONSTRATION SETTING*

1.3.1 General Description

Atlanta, the capital of the State of Georgia, is representative of many cities in the South which are experiencing rapid growth along with an active urban renewal program. Atlanta is the industrial, commercial, and financial center of the Southeast. Some 1,800 industrial plants manufacture over 3,500 different commodities including aircraft, automobiles, furniture, textiles, chemicals, iron and steel products.

The Atlanta metropolitan area encompasses seven counties (Clayton, Cobb, DeKalb, Douglas, Fulton, Gwinnett, Rockdale) and has a population of approximately 1,779,200 persons (1980 Census); the two largest counties are Fulton and DeKalb. The city of Atlanta (1980 Census population of 425,022) is predominantly contained in Fulton County, with parts of the municipal boundaries extending into DeKalb. Table 1-1 shows the breakdown of the 1975 population by county, as well as the population obtained from the 1980 Census.

*Material for this section is developed from Grant Paul and Robert Casey, Atlanta Wheelchair Accessible Bus Project, Transportation Systems Center (Cambridge, Mass.: April 1978).

TABLE 1-1. TOTAL POPULATION IN ATLANTA BY COUNTY

<u>County</u>	<u>1975 Population (Estimate)</u>	<u>1980 Population (Census)</u>
Clayton	133,200	150,357
Cobb	249,800	297,694
DeKalb	463,600	483,024
Douglas	45,600	54,573
Fulton	618,100	589,904
Gwinnett	115,400	166,903
Rockdale	28,300	36,747
Total	1,652,000	1,779,202

During the five-year period from 1975 to 1980 the overall Atlanta metropolitan population increased by approximately 8 percent. Most of this growth, however, occurred outside the counties of Fulton and DeKalb.

1.3.2 Transit Characteristics

The primary provider of transportation services in the Atlanta region is the Metropolitan Atlanta Rapid Transit Authority (MARTA). MARTA is an agency of local government created by an Act of the Georgia General Assembly in 1965. It was approved by the voters in Fulton, DeKalb, Clayton and Gwinnett Counties and the City of Atlanta in referenda the same year. When it came into existence, one of MARTA's initial task was to plan a comprehensive bus and rail transit system for the Metropolitan Atlanta area.

After rejecting previous efforts, the voters of Fulton and DeKalb Counties approved in November 1971 a plan for improving and subsidizing existing bus service and for constructing a rapid transit system with financing to come from a 1 percent local sales tax. On February 17, 1972 MARTA purchased the Atlanta Transit System, Inc. (a private bus operation) and on March 1, 1972 reduced the fare from \$.40 to \$.15 (with two free transfers) on all routes operated in Fulton and DeKalb Counties. Since then, MARTA has made numerous improvements to transit routes and schedules. Table 1-2 summarizes various ridership and operating statistics for the years 1972 to 1978.

Fares remained at the \$.15 level for seven years until they were increased to \$.25 on March 1, 1979. The fare did not change during the time period of this demonstration and evaluation. Subsequently, fares doubled to \$.50 on July 26, 1980 and in July 1981, they increased to \$.60.

TABLE 1-2. TRANSIT OPERATING STATISTICS -- FISCAL YEARS 1974-1981
(Vehicle Mileage and Passengers *1,000)

	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981(p)</u>
<u>12 Months Ending June 30:</u>								
Revenue Passengers	56,357	57,984	59,506	59,782	61,621	63,796	73,895	66,000
Transfer Passengers	<u>15,953</u>	<u>16,303</u>	<u>17,854</u>	<u>19,234</u>	<u>18,103</u>	<u>19,264</u>	<u>25,117</u>	<u>40,000</u>
Total Passengers	72,310	74,287	77,360	79,016	79,724	83,060	99,012	106,000
Vehicle Miles Operated								
Bus	24,638	26,986	27,203	27,507	28,368	30,217	31,833	31,353
Rail	0	0	0	0	0	2,000	2,820	4,061
<u>As of June 30:</u>								
Vehicles in Service								
Bus	689	715	735	765	783	841	841	820
Rail	0	0	0	0	0	20	62	98
Route Miles								
Bus	1,527	1,587	1,670	1,812	1,918	1,991	1,926	1,889
Rail	0	0	0	0	0	6.7	11.8	11.8

SOURCE: Metropolitan Atlanta Rapid Transit Authority.

MARTA is currently constructing a 61-mile rapid transit system in DeKalb and Fulton counties. The preliminary design of the 53-mile rapid rail and 8-mile rapid busway system began in 1973. In 1975 construction began on the 13.7-mile 17 station Phase A segment. Phase A includes the 6.7-mile East Line that opened on July 1, 1979; the 5.1-mile West Line that opened on December 22, 1979; and the 1.9-mile North-South Line which began revenue service on December 1, 1981.

The full system will include 39 rail transit stations and 2 busway stations with over 30,000 parking spaces. The rail and busway system will be coordinated with surface bus operations that will be operating on over 1,350 miles of streets and expressways in the two county area. The rapid rail portion of the entire system, as shown in Figure 1-1, will include 10 miles of subway with 13 stations, 16 miles of aerial lines with 7 stations, and 27 miles of at-grade construction with 19 stations. The rapid busway portion of the system will consist of 8 miles of at-grade line, 2 stations and several intermediate bus ramps.

1.3.3 TransCard Information

TransCard was introduced by MARTA in March 1979. The unlimited-use, nontransferable pass was priced at \$10 per month, representing a breakeven level of 20 round trips per month. (The pass price remained constant throughout the course of this evaluation. When fares were increased to \$0.50 and a weekly pass was introduced in July 1980, the breakeven trip rate of the monthly pass was reduced to 17.) The majority of TransCards are sold at MARTA's "Ridestore," which is centrally located in the Atlanta CBD district (62-A Peachtree Street across from Central City Park). Passes are also available to the general public at about 20 other participating sales outlets (banks and newstores), and through the mail. During the course of this evaluation, very few passes were sold through employers.

Figure 1-2 depicts the various transit fare cards available to MARTA. The TransCard is used as a flash pass to board a bus and as a state-of-the-art fare card to enter the rail stations. The bus/rail transfer cards are obtained from a bus driver by cash-paying riders who will transfer to the rail line (except for bus routes entering the barrier-free stations). The "1/2-fare permit" card is for use by the elderly and handicapped while the "special" fare card can be programmed for use over any given number of days.

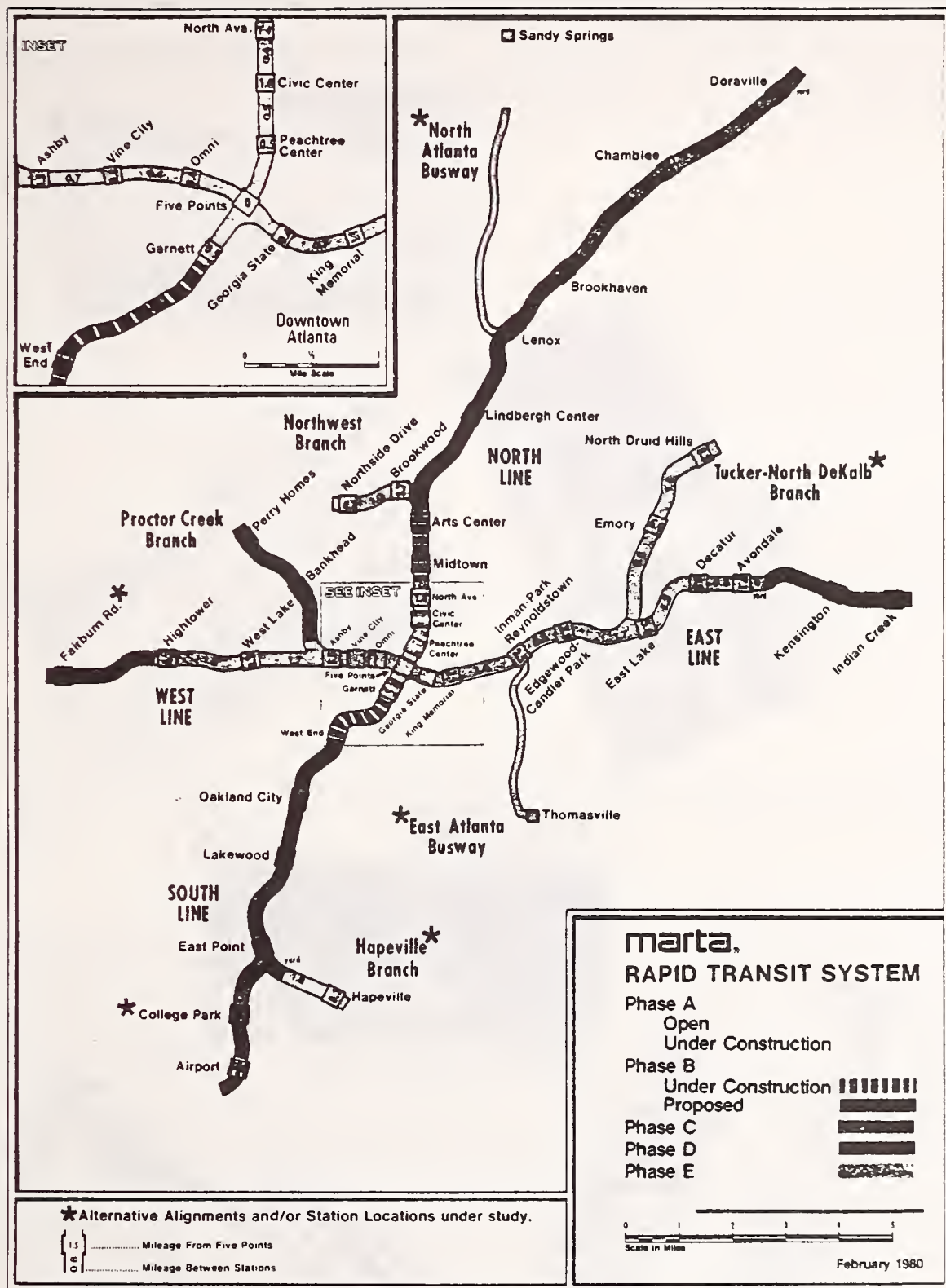


FIGURE 1-1. MARTA RAPID TRANSIT SYSTEM MAP



FIGURE 1-2. MONTAGE OF MARTA'S TRANSIT FARE CARDS

1.4 ORGANIZATIONAL ROLES OF EVALUATION PARTICIPANTS

The organizations that were involved in the Atlanta Integrated Fare Collection Demonstration and their relationship to one another are shown in Figure 1-3. The role that each organization played in the demonstration and evaluation is briefly described below.

1.4.1 Metropolitan Atlanta Rapid Transit Authority

MARTA, the recipient of the demonstration grant from UMTA, was responsible for administrative and budgetary control of the project, as well as all work activities including the data collection activities described in the annotated Data Collection Plan.* MARTA obtained and supervised personnel to implement the various surveys, and performed data coding, keypunching and quality checks on the data.

MARTA is also the operating agency responsible for planning and implementing the various phases of the demonstration. Among other things, this included activities associated with selling and promoting the monthly TransCard, establishing fare levels, transfer rules, bus scheduling, and operation of the rail system.

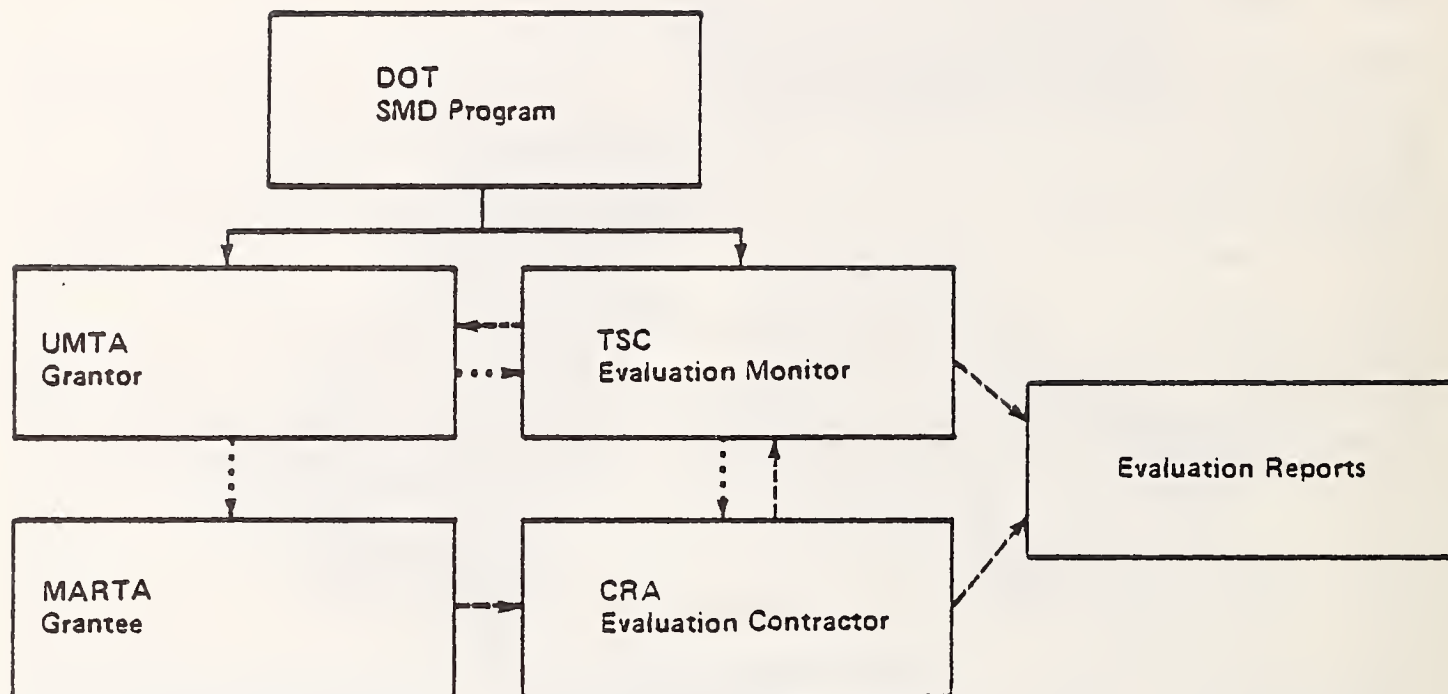
1.4.2 Urban Mass Transportation Administration (UMTA)

UMTA is the Service and Methods Demonstration (SMD) sponsor for the Atlanta project and was responsible for overseeing and guiding all aspects of the demonstration.

1.4.3 Transportation Systems Center (TSC)

Overall responsibility for the evaluation rests with the Transportation Systems Center, which is a division of the Research and Special Programs Administration of the U.S. Department of Transportation. It is TSC's task to select and monitor the activities of the evaluation contractor as well as to specify the technical direction of the evaluation. Both TSC and the evaluation contractor interact with the grant recipient to obtain the data necessary for the evaluation of the demonstration. TSC also coordinates and synthesizes the findings of the present evaluation with those from similar demonstration projects.

*Charles River Associates, Atlanta Integrated Fare Collection Demonstration: Annotated Data Collection Plan, prepared for the Transportation Systems Center, (Boston, Mass.: CRA, August 1979).



LEGEND

- > Evaluation Data
-> Contract

DOT = U.S. Department of Transportation
 UMTA = Urban Mass Transportation Administration
 TSC = Transportation Systems Center
 MARTA = Metropolitan Atlanta Rapid Transit Authority
 CRA = Charles River Associates

FIGURE 1-3. ORGANIZATIONS AND ROLES FOR THE ATLANTA DEMONSTRATION

1.4.4 Charles River Associates (CRA)

CRA served as the evaluation contractor under a separate contract to TSC. As such, CRA was responsible for monitoring and evaluating the demonstration project, including preparation of monthly Progress Reports, and this Final Evaluation Report. CRA, in consultation with TSC, UMTA, and MARTA, established appropriate data collection strategies, implementation procedures, and quality control checks for the reduction and transmittal of data.

1.5 DEMONSTRATION IMPLEMENTATION AND SCHEDULE

The staging of the various demonstration phases and data collection activities is shown in Figure 1-4. The first demonstration phase began on March 1, 1979 when TransCard was introduced and base transit fares increased. The next major event was the opening of the East Rail Line which occurred on July 1, 1979. Bus lines were reconfigured to feed the East Line rail stations on October 13, 1979. The West Rail Line opened on December 22, 1979 while feeder bus service on the West Line did not begin until June 1980, one month following the after surveys.

To collect data on individual transit travel behavior, a before on-board bus survey was conducted during the period May 10-31, 1979. Data on the access characteristics of rail transit users were obtained from an on-board rail (pre-test) survey on November 12, 1979. Lastly, the after on-board bus and rail surveys were conducted in May 1980, one year after the before bus survey.

Typically evaluations of transportation system changes focus on collecting data on the characteristics of travelers and their travel behavior both before and after the supply change being analyzed. However, the first phase of the Atlanta demonstration -- consisting of the systemwide fare increase from \$0.15 to \$0.25 and the introduction of TransCard on March 1, 1979 -- was occurring concurrently with the selection of Atlanta as a demonstration site of fare integration. Consequently, the analysis of the first phase of the demonstration relied, to the extent necessary, on the use of retrospective questions concerning changes made in travel behavior since the time of the fare increase and introduction of TransCard.

Besides the general concern of retrospective questions (i.e., memory lapses), a major disadvantage of this approach is that individuals who change their travel mode (in effect reducing their transit trip frequency to zero) will not be represented in the on-board bus ridership survey. As described in a later section, however, it is possible to construct reasonable bounds on the number of individuals and the number of trips that they made prior to the fare increase.

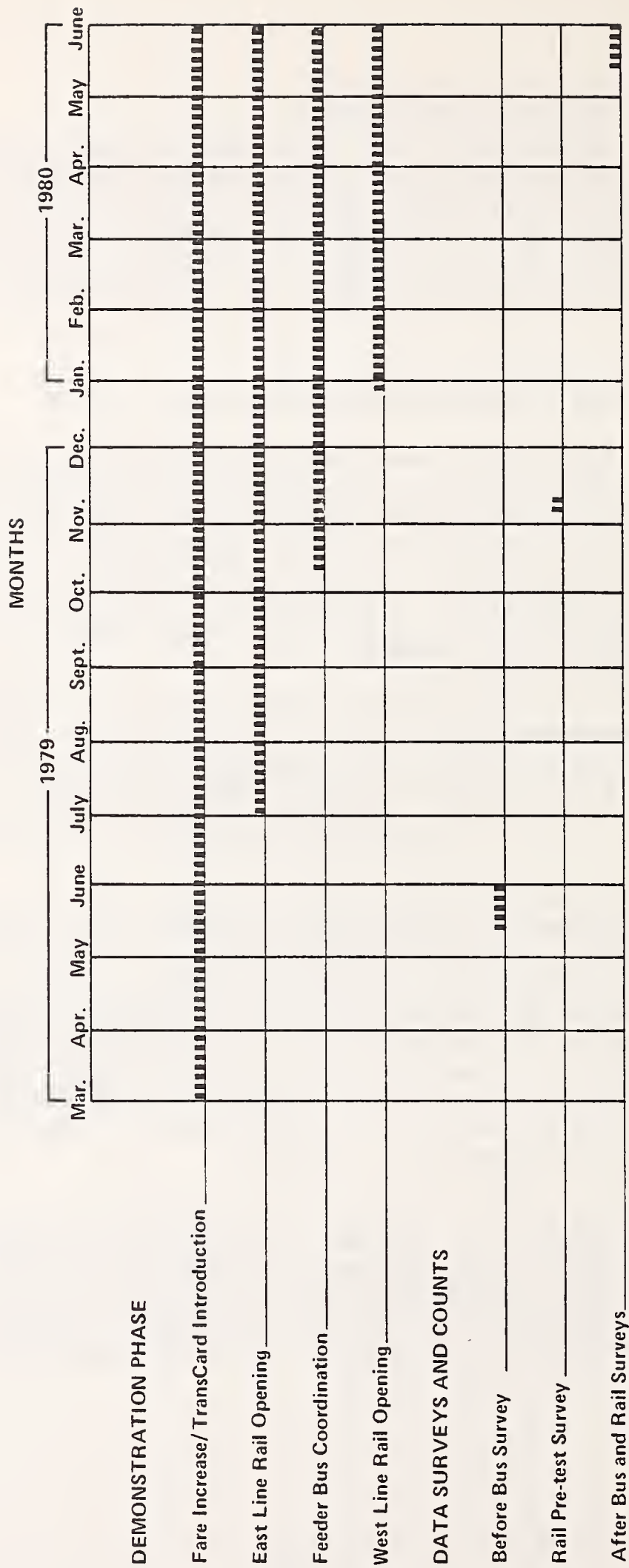


FIGURE 1-4. DEMONSTRATION PHASES AND DATA COLLECTION ACTIVITIES

In prior ridership surveys, MARTA has divided the bus system service area into approximately three equal sections consisting of 1) the East Corridor which extends from the Atlanta CBD eastward, incorporating the East Rail Line and its catchment area; 2) the West Corridor which is symmetrically opposite of the East Corridor (and in a later phase of this demonstration, included the West Rail Line); and 3) the Central or North/South Corridor which contains all the remaining territory. The on-board surveys used in the evaluation were designed and implemented to be consistent with this segmentation.

In order to obtain relatively complete and reliable responses to the survey questions, all surveys were personally administered. This approach avoids the problem of relatively low response rates associated with self-administered post card surveys and the uncertainty associated with biased or disproportionate response rates from either pass or cash users or along any other market segment dimension (e.g., income). The questionnaire and data collection plans were developed by CRA with the assistance of TSC and MARTA. The on-board bus surveys were administered by MARTA personnel on a representative sample of bus routes equally divided by corridor of the city and over six time periods: morning peak, midday, afternoon peak, evening and all day Saturday and Sunday.

The determination of the number of bus routes to be surveyed was based on the number of surveys that can be completed over a given time period and the total sample size required. The total sample size is a function of the accuracy desired and the eventual use of the data. Because of the desire to examine differences in transfer rates, for example, by fare payment type (i.e., pass and cash users) and by different socioeconomic categories, a relatively large sample size was required. To achieve these objectives, a minimum total sample size of 4000 usable surveys consisting of 2000 TransCard and 2000 cash fare users was determined.*

In the before and after bus surveys, interviewers were instructed to administer the survey to every fifth boarder, but alternating between cash and TransCard users. Thus, the survey was stratified by fare payment type but was random for individuals within a fare category.

Unlike the bus on-board surveys, no attempt was made to obtain interviews from equal numbers of cash and TransCard rail users. Instead it was hoped that the sample would resemble the true population in this respect and perhaps corroborate an independent count-based estimate of 28 percent

*Larry Doxsey, "Atlanta Survey Sample Size Selection," Transportation Systems Center Memorandum, March 19, 1979.

TransCard usage on rail.* This in fact occurred, 28.3 percent of the interviews on the rail system were with TransCard users.

During the rail survey, interviewers started out at opposite ends of the rail line and stopped every fifth person who came onto the train platform. Each individual was asked whether they were coming from bus, and if so, they were not interviewed. The same question was asked of the next boarder until a user who did not transfer from a bus was found. The interview was done in person with the interviewer following the passenger onto the train if necessary. When this occurred and the interview was completed, the interviewer got off the train and interviewed the fifth person coming to board at that station. In each case, the interviewer continued in the direction of the interviewee when it was necessary to reboard the train. This generally took the interviewer from one end of the rail line to the other, but in the case of a center platform, the fifth person might well take the interviewer back the other direction.

The hard copy survey questionnaires (shown in Appendix A) were coded, keypunched, and transferred to a magnetic tape by MARTA staff. CRA received the tape, performed various range checks, and used the Statistical Analysis System (SAS) package to perform the various data manipulations and summaries that are reported herein. TransCard and cash users were weighted separately by the inverse of weekly transit trip frequency to remove the overrepresentation in the sample of individuals with high transit trip frequencies. Therefore, the information presented describes the characteristics of individual transit users rather than transit boarders.

*John W. Bates, Memorandum "Expansion of May 1980 TransCard/Integrated Fare Collection Evaluation Survey Data to Month Total Ridership Volumes," September 18, 1980.

2. DEMONSTRATION FINDINGS

2.1 OVERVIEW

Section 1 of this report presented a general overview discussion of the issues to be addressed in the Atlanta demonstration. In this section, the demonstration findings are presented and organized according to the following five subject (or issue) categories that were specified in the Data Collection Plan:*

- Pass Implementation Impacts;
- Fare Increase Effects;
- Modal and Intermodal Integration;
- Station Design (Barrier-Free); and
- Rail System Effects.

As discussed in the next section below, pass implementation impacts refer to issues that directly result from the introduction of the monthly transit pass. Example items of interest include the characteristics of individuals who buy the pass and how they differ from nonpass transit users, reasons why the pass was or was not purchased, the effect purchasing a pass has on transit travel, and so forth.

In a similar fashion, fare increase effects are restricted to an analysis of issues generated just from the increase in fares. Questions examined include an analysis of transit travel changes made by different market segments, the question of reduced trip frequency versus lost riders, and the impact on gross transit revenues. Modal and intermodal issues relate to how the availability of an unlimited use transit pass facilitates the use of two or more transit vehicles of the same (i.e., bus-to-bus) or different (i.e., bus-to-rail) modes. In addition, the second subset of issues in this category concern differences that exist between a bus-rail interface with and without a complementary feeder bus network.

*Charles River Associates, Atlanta Integrated Fare Collection Demonstration: Annotated Data Collection Plan, prepared for the Transportation Systems Center, (Boston, Mass.: CRA, August 1979).

The station design category covers issues related to the existence and use of the barrier-free rail transit station. Specific questions that are addressed include whether or not this type of intermodal station has a positive influence on transit use, and how it compares to the integration effects of TransCard.

Lastly, rail system effects include issues that relate to the opening of the East and West Rail Lines and also the separate integration effects of a feeder bus network versus the TransCard.

2.2 PASS IMPLEMENTATION IMPACTS

Unless otherwise noted, the findings presented in Sections 2.2.1 through 2.2.6 below are based on the before on-board bus survey conducted in May 1979 while Section 2.2.7 (which examines pass buying behavior over time) relies on data from the after on-board surveys conducted during the month of May 1980.

2.2.1 Socioeconomic Characteristics of TransCard and Cash-Paying Individuals

Various socioeconomic characteristics of individuals who paid fares by cash* or by using a TransCard are presented in the top half of Table 2-1. The table lists the mean, standard deviation, sample size and t-statistic which can be used to test the hypothesis that there is no difference between the means (i.e., $H_0: U_1 - U_2 = 0$). (Appendix B describes how these t-statistics were calculated.) The last column in Table 2-1 indicates whether the null hypothesis is accepted or rejected at a 95 percent level of confidence. As is readily apparent, the null hypothesis was rejected in almost all instances implying that a statistical difference does exist between the characteristics of TransCard and cash-paying individuals. In some instances, however, the "difference" is relatively small and yet is significant; this is due to the appropriate, but relatively large sample size.

The numerical findings of Table 2-1 are presented as concise summary statements in Table 2-2. In broad terms, the results indicate that those socioeconomic characteristics traditionally associated with frequent transit users are also associated with TransCard purchasers.

*Cash users include individuals who boarded and paid a cash fare as well as individuals who boarded with a transfer slip obtained by paying a cash fare on a previous bus.

TABLE 2-1. SOCIOECONOMIC AND TRAVEL BEHAVIOR CHARACTERISTICS OF CASH AND TRANSCARD INDIVIDUALS

Characteristic	Cash			TransCard			t-Statistic	Hypothesis
	Mean	S.D	n	Mean	S.D	n		
Age (years)	34.30	15.55	2372	34.33	14.01	2132	- 0.07	Accept
Income (dollars)	12,007	8425	1980	10,521	7284	1820	5.8	Reject
'Auto' available	0.48	0.50	2431	0.34	0.47	2191	9.8	Reject
Sex - Male (percent)	41.6		1015	39.2		860	1.7	Borderline
Sex - Female (percent)	58.4		1423	60.8		1337	1.7	Borderline
Race - Minority (percent)	70.4		1717	74.9		1645	3.4	Reject
Race - Non-Minority (percent)	29.6		721	25.1		552	3.4	Reject
Total # of transfers	0.740	0.782	2441	0.897	0.816	2200	- 6.7	Reject
Total # bus trips/week	8.86	5.59	1892	13.26	4.69	2034	- 26.6	Reject
# work bus trips/week (one-way)	5.85	4.50	2134	8.77	3.60	2122	- 23.4	Reject
# non-work bus trips/week	3.22	3.67	2131	4.46	4.66	2068	- 9.6	Reject
# additional work bus trips per week (one-way)	- 0.005	1.04	2134	0.58	1.81	2122	-12.9	Reject
# additional other bus trips per week (one-way)	- 0.013	1.18	2131	1.06	2.54	2068	-17.0	Reject
Total # additional bus trips/week (one-way)	- 0.01	1.80	1892	1.63	3.40	2034	-19.1	Reject
# prior bus work trips/week	5.85	4.52	2134	8.19	3.79	2122	-18.3	Reject
# prior other bus trips/week	3.23	3.73	2131	3.41	4.18	2068	- 1.47	Accept
# prior total bus trips/week	8.87	5.64	1892	11.63	4.67	2034	-16.6	Reject

SOURCE: MARTA On-Board Bus Survey (May 1979)

TABLE 2-2. SUMMARIZED STATEMENTS OF FINDINGS:
SOCIOECONOMIC AND TRAVEL BEHAVIOR CHARACTERISTICS
OF CASH AND TRANSCARD INDIVIDUALS

1. Age
No difference between cash and TransCard individuals.
2. Income
TransCard users have lower incomes than cash users.
3. Auto Availability
TransCard users are less likely to have an auto available.
4. Sex
Females are slightly more likely to be TransCard purchasers than are males.
5. Race
Minorities are slightly more likely to be TransCard users.
6. Transfers
TransCard users make more transfers than cash users.
7. Bus Work Trips
TransCard individuals make about three more (one-way) bus work trips per week than cash-paying individuals.
8. Bus Nonwork Trips
TransCard users make about one and one-third more (one-way) bus nonwork trips per week than cash users.
9. Additional Bus Work Trips
TransCard users made an average of 0.6 additional work trips per week, while cash users made no additional bus work trips.
10. Additional Bus Nonwork Trips
TransCard users made an average of 1.1 additional nonwork bus trips per week, while cash users made no additional trips.

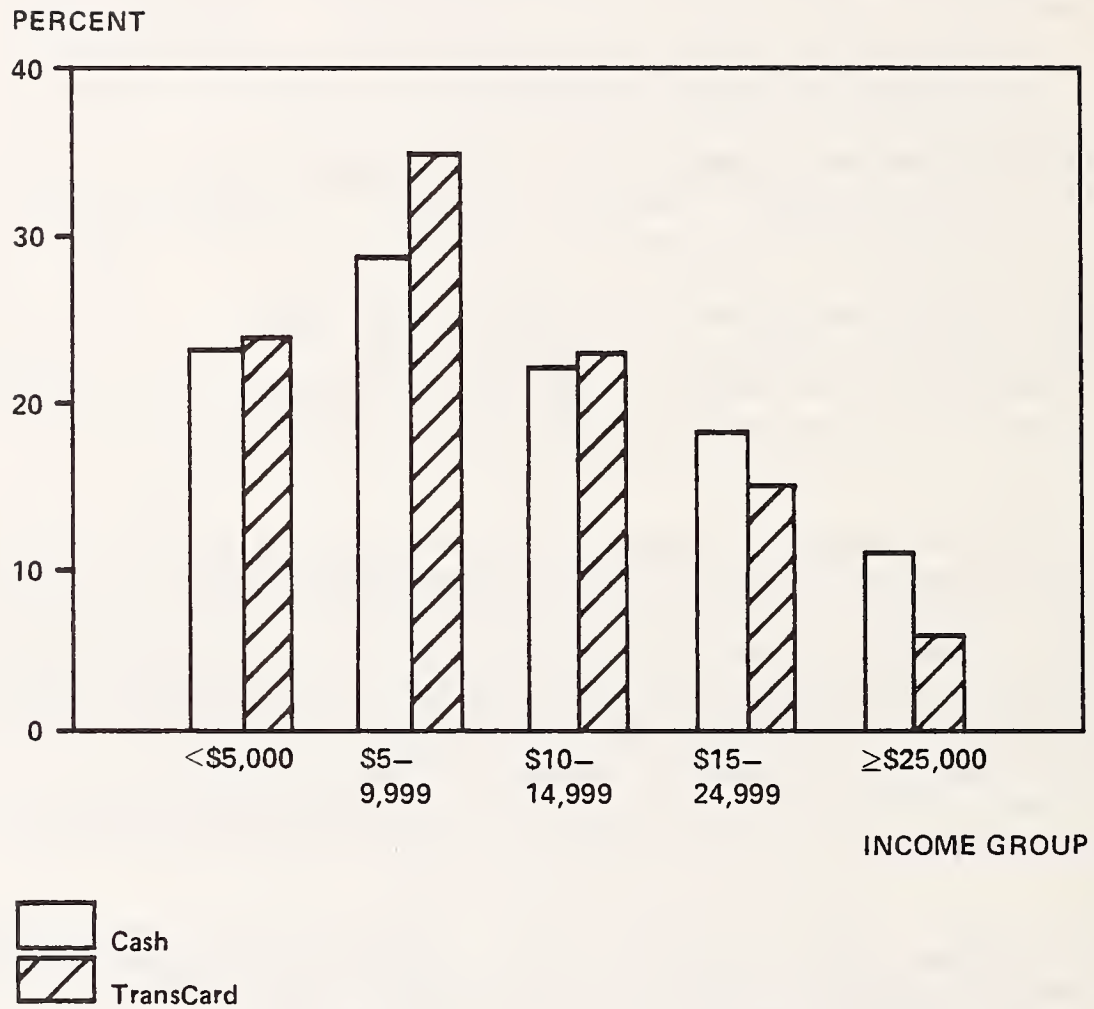
Another useful way to make comparisons between cash and TransCard users is through the use of cross tabulations.* For example, Figure 2-1 presents a frequency distribution showing the percentage of cash and TransCard individuals in each income category. The figure reveals that while individuals with the lowest incomes are only slightly more likely to purchase a TransCard, higher income individuals are much less likely to buy a TransCard. On a relative basis, the highest percentage of TransCard purchases are made by individuals in the \$5,000 to \$10,000 income group, which could be referred to as "the working poor." Fewer passes are purchased by individuals with household incomes less than \$5,000 as this group likely contains many persons who are not fully employed and therefore do not make enough commutation trips by bus to save money with a pass.

Because of the stratified sampling approach that was used, some care must be taken in interpreting this and other figures presented in this report. That is, although the before on-board bus survey sample contains roughly 50 percent cash and 50 percent TransCard boarders, the population share of bus boarders is estimated at 83.1 percent cash and only 16.9 percent TransCard.** Therefore, it would be incorrect to infer from Figure 2-1, that there are more TransCard than cash users -- on an absolute basis -- in the income range of \$5,000 to \$9,999. This is illustrated clearly in Figure 2-2 which was derived by weighting the sample by the disproportionate sampling rate such that the figure now represents proportions for total systemwide bus ridership.

Graphs, similar in concept to Figure 2-1 that compare cash and TransCard individuals by age and auto availability are shown in Figures 2-3 and 2-4 respectively. Figure 2-3 indicates that relatively few TransCards are purchased by individuals who are either less than 16, or older than 65. Generally, we would expect these groups to contain fewer full-time workers. On a relative basis, passes are most popular with individuals in the 40-59 year old age group. As one might expect, Figure 2-4 reveals that individuals without an auto available are much more likely to buy a TransCard.

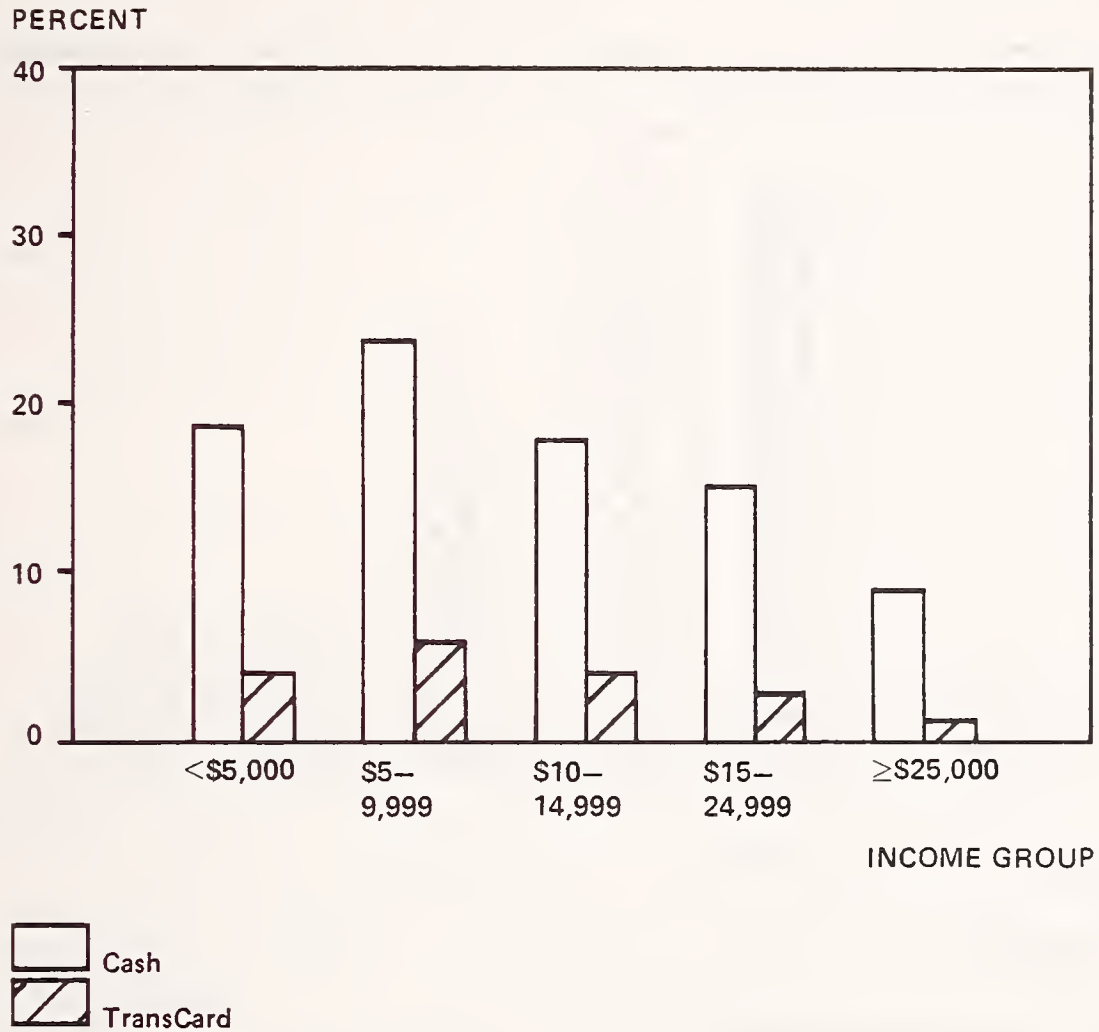
*These cross tabulations are univariate in that only one characteristic is examined at a time. While useful in this context, this approach cannot separate out the effects of other, and possibly more dominant characteristics. A multivariate analysis of pass buyers is presented in Section 2.4.1.

**This estimate was determined by performing an independent count of fare payment type by boarders on a random sample of 385 bus vehicle trips.



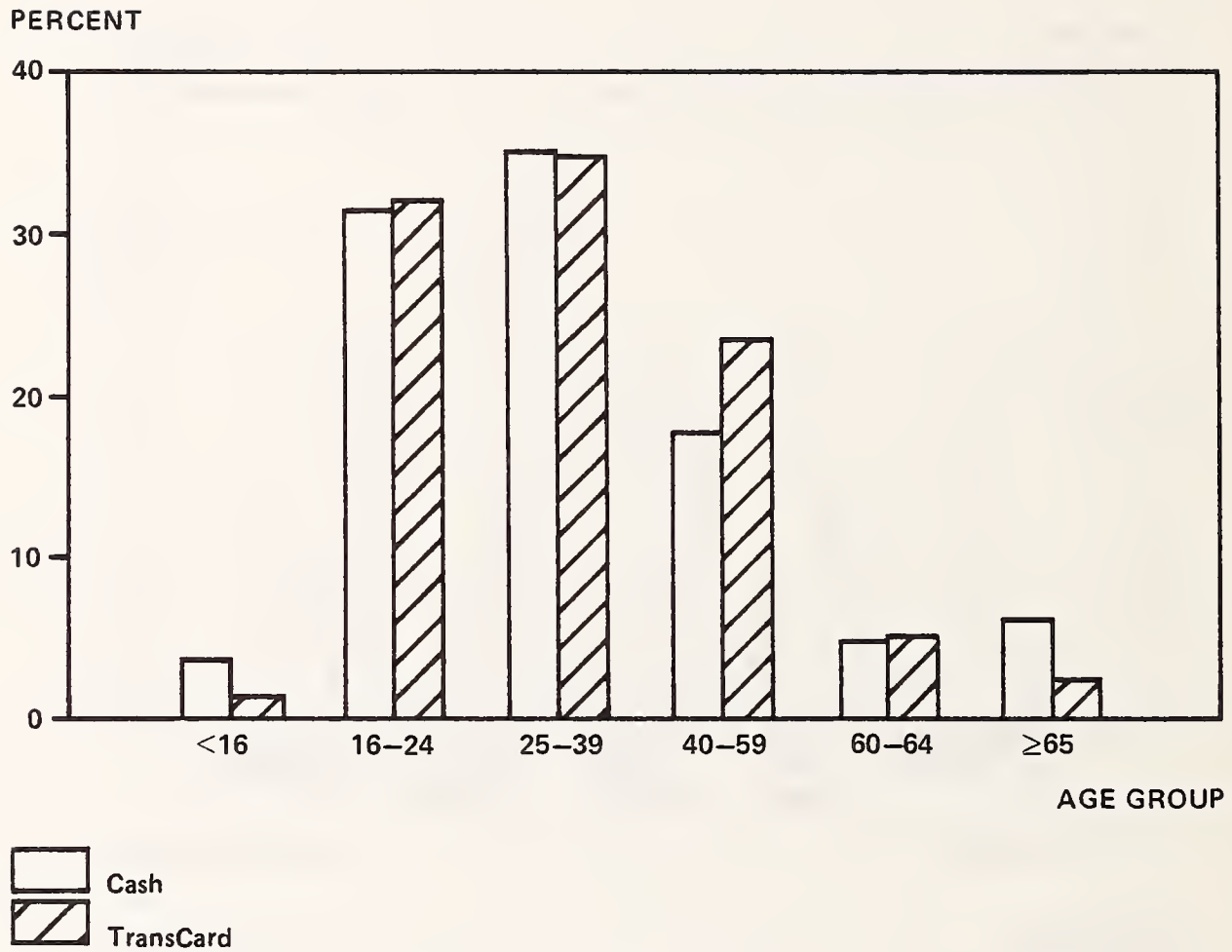
SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-1. INCOME CHARACTERISTICS OF CASH AND TRANSCARD INDIVIDUALS



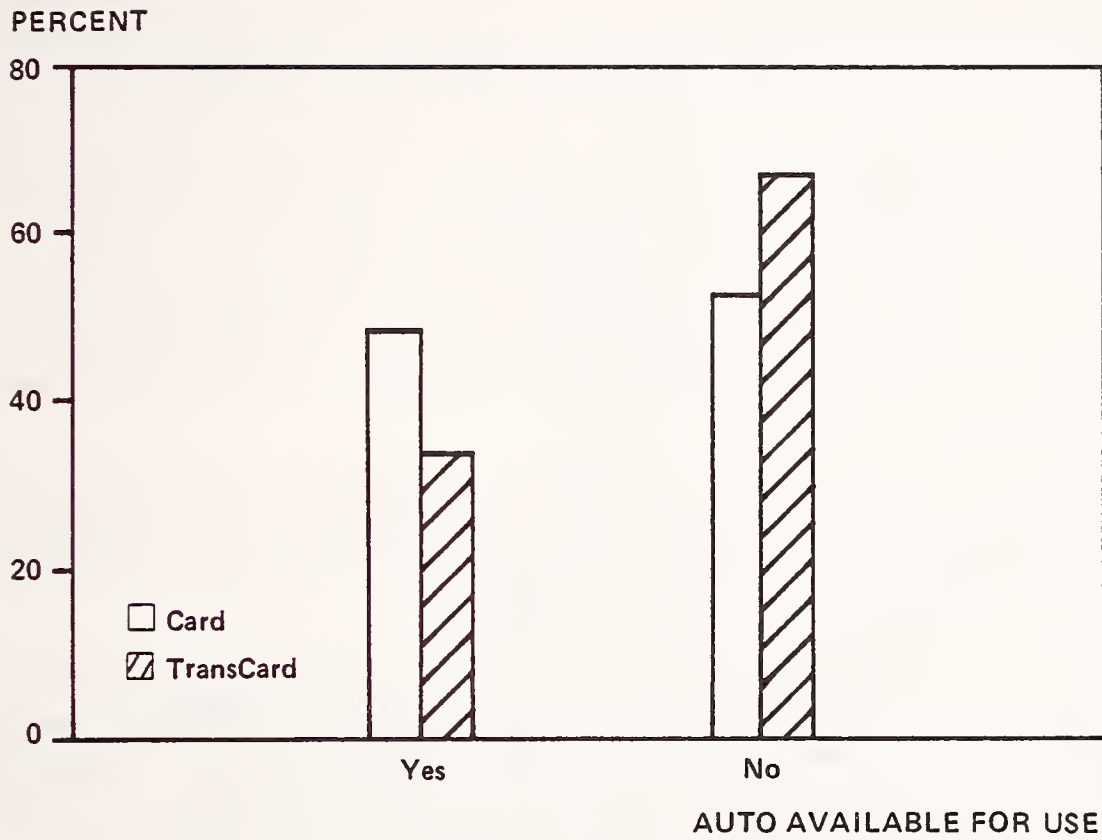
SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-2. PERCENTAGE OF SYSTEMWIDE RIDERSHIP THAT REPRESENTS CASH AND TRANSCARD USERS, BY INCOME CATEGORY



SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-3. AGE CHARACTERISTICS OF CASH AND TRANSCARD INDIVIDUALS



SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-4. AUTO AVAILABILITY CHARACTERISTICS OF CASH AND TRANSCARD INDIVIDUALS

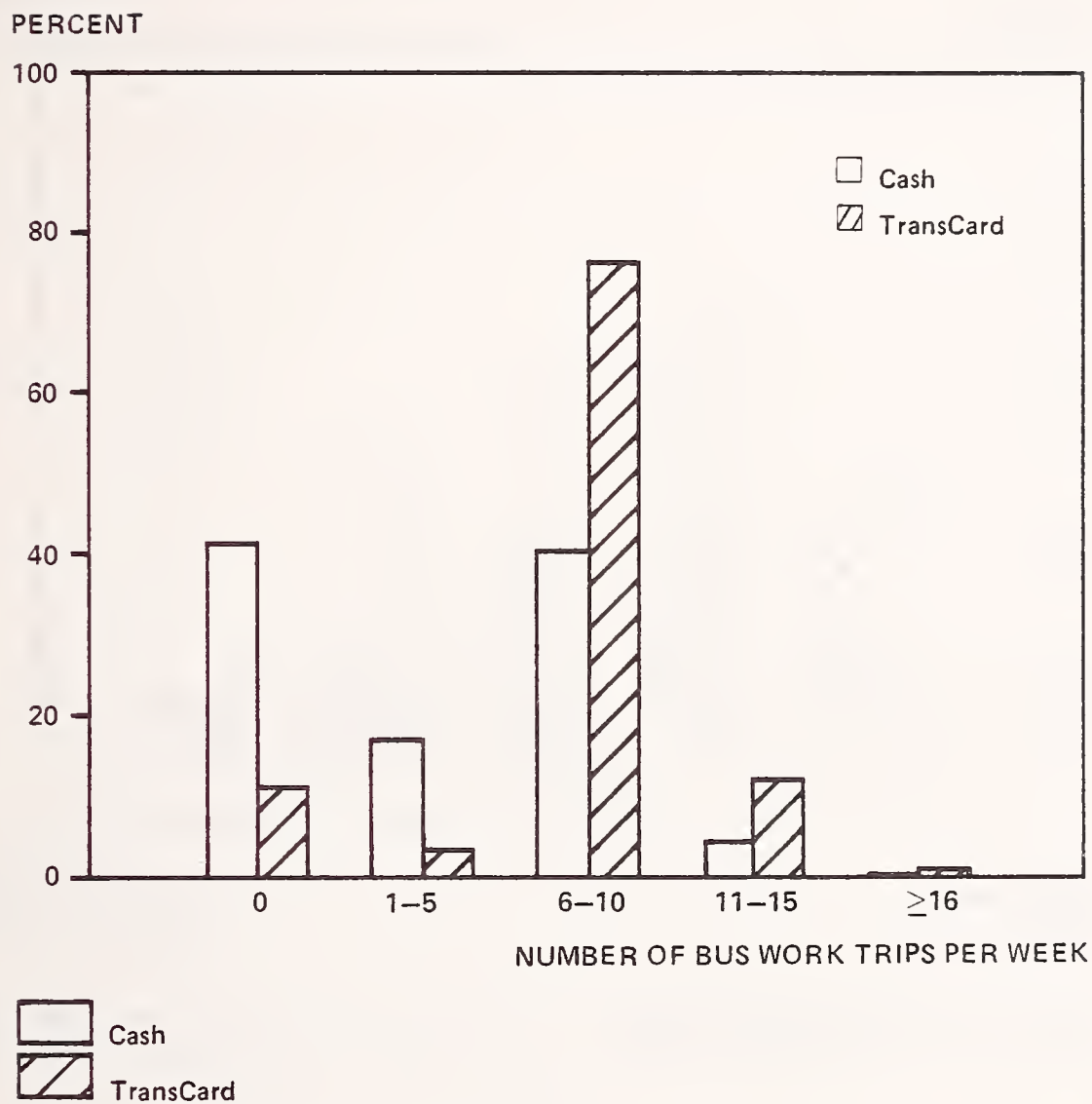
2.2.2 Transit Ridership Characteristics of TransCard and Cash Users

Travel behavior questions of interest consist of the number of transit trips made by cash and TransCard users both before and after the introduction of the pass, and the extent to which monthly transit pass purchasers increased the number of trips taken by transit. To this end, Table 2-1 lists the mean number of work and nonwork bus trips taken per week by cash and TransCard bus users. For TransCard users, Table 2-1 also provides the mean number of additional or new one-way work and nonwork bus trips taken per week since the pass was purchased. For cash users, the change in the mean number of one-way work and nonwork bus trips per week, since the time of the fare increase, is also listed. With this information it is possible to compute the number of work and nonwork bus trips per week that were made prior to the systemwide fare increase and introduction of TransCard that occurred on March 1, 1979. As summarized in Table 2-2, individuals who purchased a TransCard increased their use of transit by 1.6 trips per week while cash-paying individuals, who continued to use transit, did not change their transit trip frequency. About about two-thirds of the increased number of trips by TransCard users were made for nonwork trip purposes.

Figure 2-5 shows that there is a strong relationship between the number of transit trips taken per week to or from work and whether an individual purchases a TransCard. Figure 2-6 shows a similar but less pronounced relationship for nonwork bus trips per week.

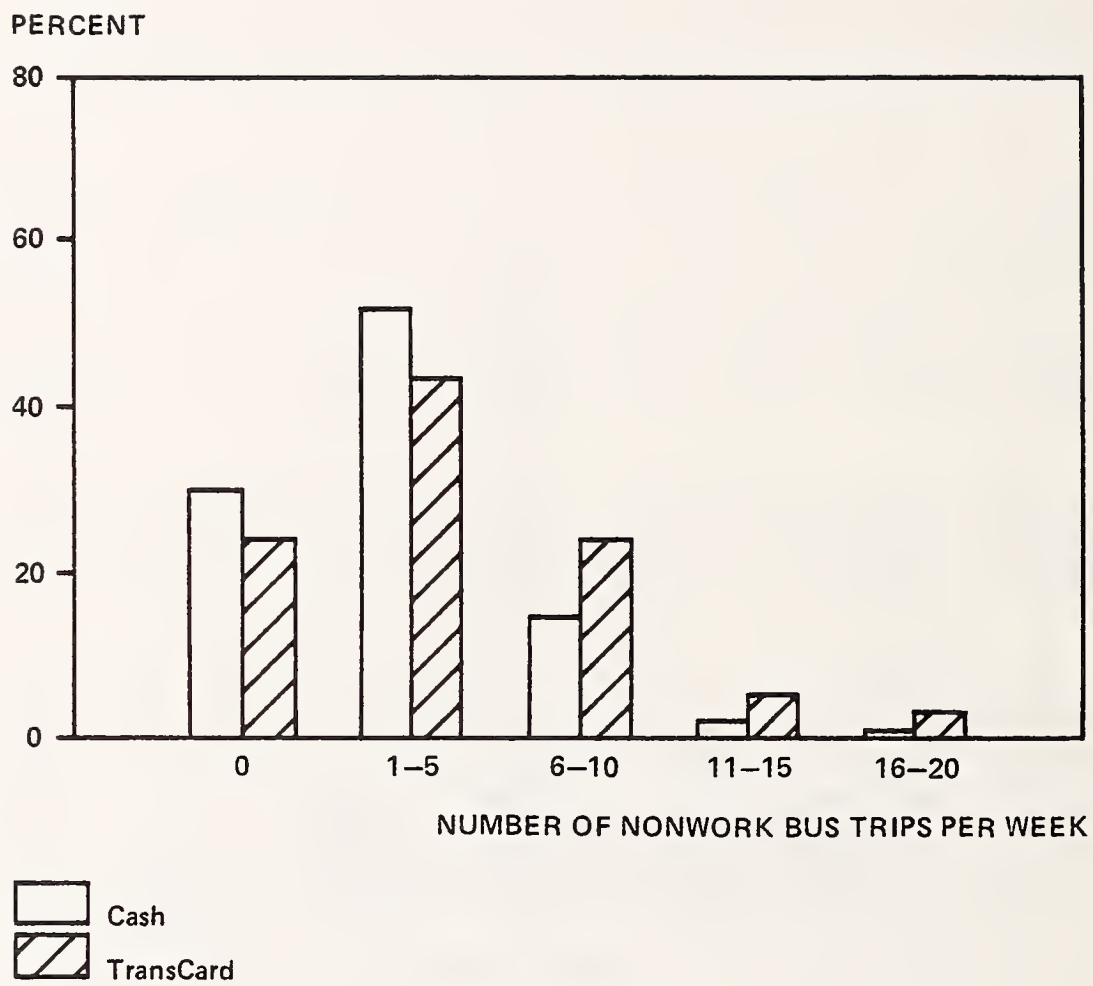
Figure 2-7 depicts the total number of transit trips made per week (i.e., the sum of the work and nonwork transit trips presented in Figures 2-5 and 2-6) for cash and TransCard individuals. It is readily apparent from Figure 2-7 that TransCard use becomes significant only when the number of transit trips taken per week equals or exceeds 10. (Note that 85 percent of the individuals in the 6-10 trip per week group make exactly 10 transit trips per week.) By comparing Figures 2-5 and 2-6, it is obvious that the number of transit trips taken for the work trip purpose is more important in the decision to purchase a pass than is the number of transit trips made for nonwork purposes. It would appear, therefore, that a transit pass has its greatest appeal to regular worktrip commuters.

In addition to showing that the vast majority of TransCard individuals make the same or more than the "breakeven" number (i.e., 10) of transit trips per week (mean equals 13.3 trips per week), it is also apparent from Figure 2-7 that a large number of individuals make many more than the breakeven number



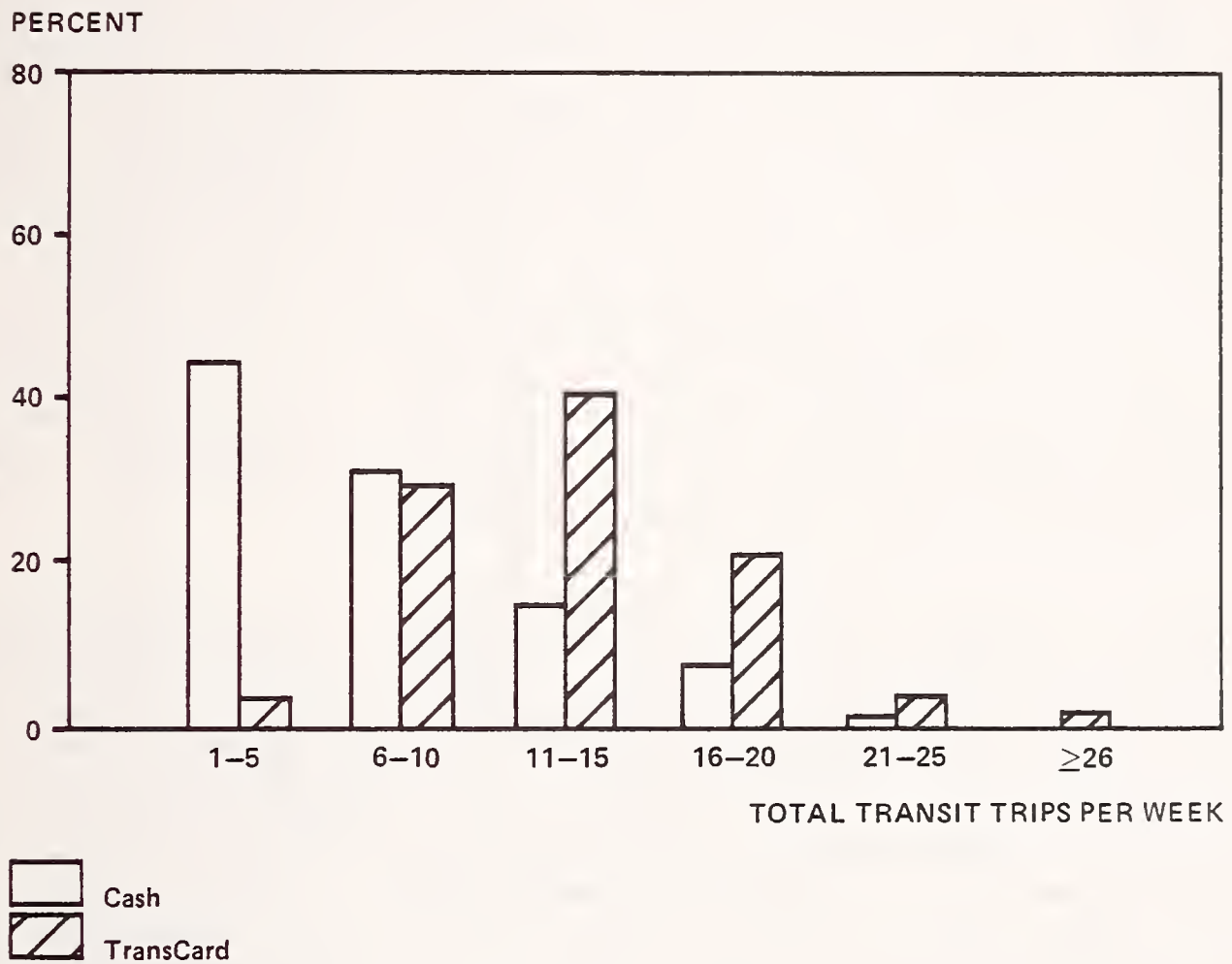
SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-5. TRANSIT WORK TRIP FREQUENCY CHARACTERISTICS OF CASH AND TRANSCARD INDIVIDUALS



SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-6. TRANSIT NONWORK TRIP FREQUENCY CHARACTERISTICS OF CASH AND TRANSCARD INDIVIDUALS



SOURCE: On-board Bus Survey, May 1979.

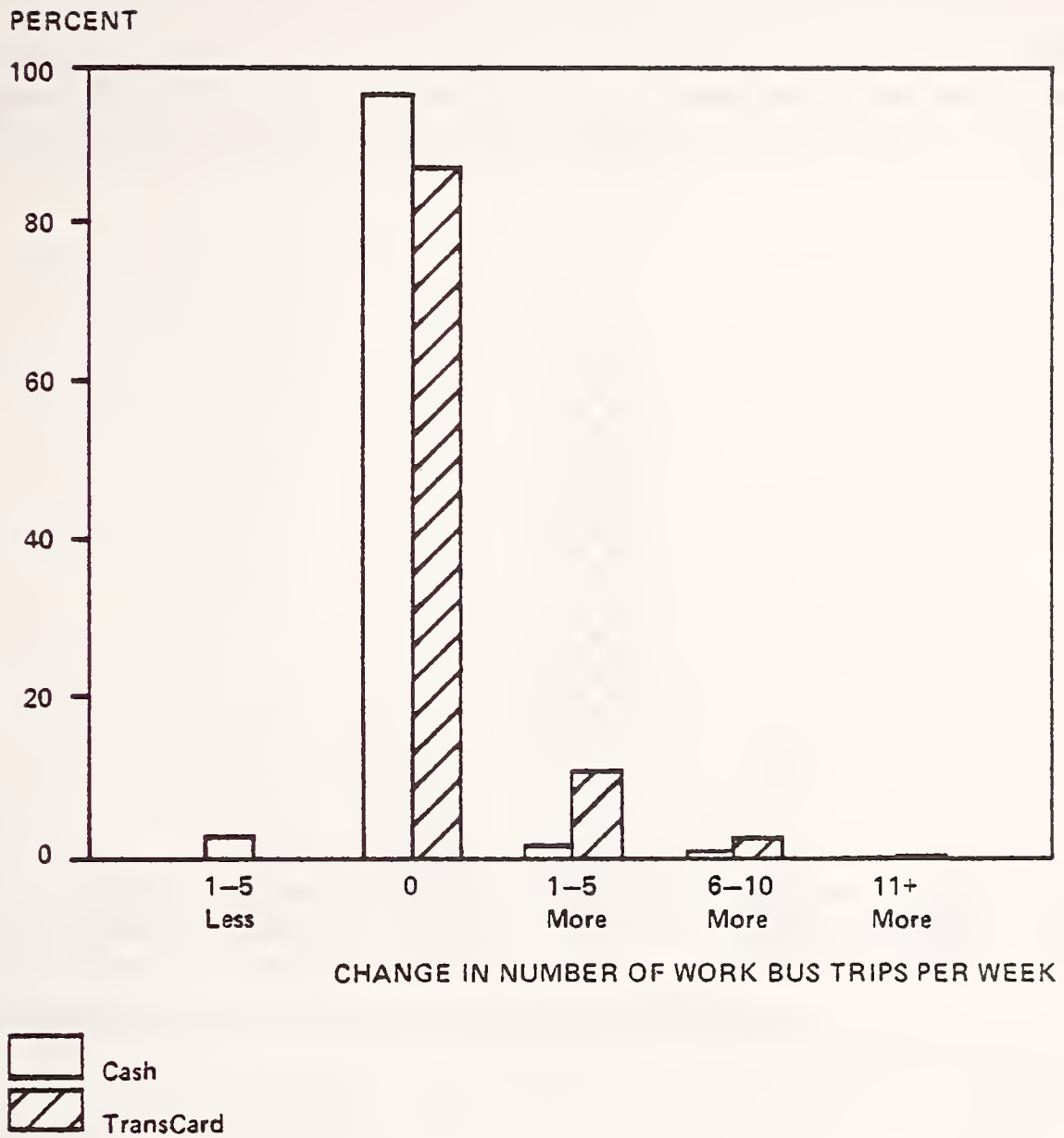
FIGURE 2-7. TOTAL TRANSIT TRIP FREQUENCY CHARACTERISTICS OF CASH AND TRANSCARD INDIVIDUALS

of trips per week (and presumably per month), but continue to pay cash fares. Although these individuals appear to be heavy users of the system, they are clearly not taking advantage of the TransCard to save money or to offset the impact of the fare increase.

Table 2-1 provided the mean number of additional work and nonwork bus trips taken per week for cash and TransCard individuals. The frequency distributions for the change in transit work and nonwork trip making for cash and TransCard individuals are shown in Figures 2-8 and 2-9. For both work and nonwork transit trips the vast majority of the individuals who pay with cash fares reported no change in weekly bus trip frequency after the fare increase. Those cash users who did change trip frequency since the fare increase were nearly evenly split between those who increased and those who decreased transit tripmaking (not including those who switched completely from the transit mode). To be consistent with the body of literature on elasticities, one must conclude that the normal reduction in aggregate transit trip making by cash-paying individuals after a fare increase is due mainly to individuals who leave the system entirely (i.e., change modes) rather than by individuals who simply reduce their transit trip frequency. Of course, on a disaggregate basis there are those who do cut back on the number trips taken by transit, but the information presented here indicates that they are offset by individuals increasing their transit trip frequency. (See Section 2.3.2 for further details on this point.)

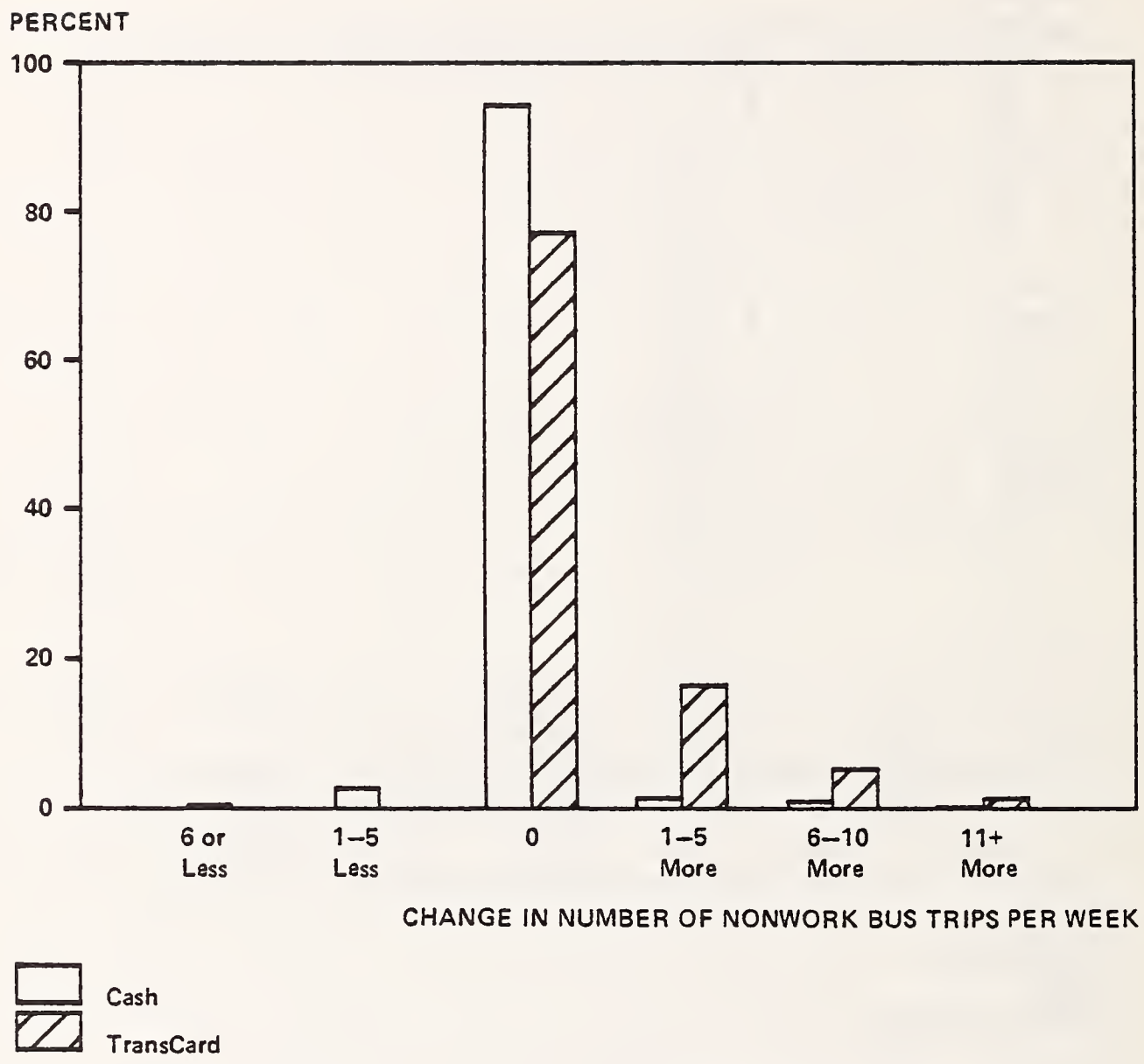
As Figures 2-8 and 2-9 reveal, TransCard users were more likely to increase the number of nonwork trips rather than the number of work trips taken by transit.* Basically, since TransCard purchasers were already frequent users of transit for commuter work trips, they had less opportunity to make even more work transit trips once they bought a TransCard. However, without a similar "upper limit" on the number of nonwork trips that can be made, individuals who bought a pass increased in both absolute and relative terms the number of transit trips made for discretionary or nonwork purposes. This finding is even more significant when one considers that the increase in work trips includes TransCard individuals who stated that they increased work transit trips by 10 or more and consequently were likely "new" to the system (i.e., they made a change in mode). In fact, Figure 2-10 indicates that 3.6 percent of the TransCard users were apparently "new" riders (i.e., they reported making no transit trips per week prior to buying a TransCard).

*It should be noted that the questionnaire did not ask whether new TransCard users reduced the number of trips taken by transit after they bought a pass. Although it is likely that some pass users might have made fewer trips, Figure 2-8 suggests that the number would be negligible, considering that very few cash users made fewer work transit trips.



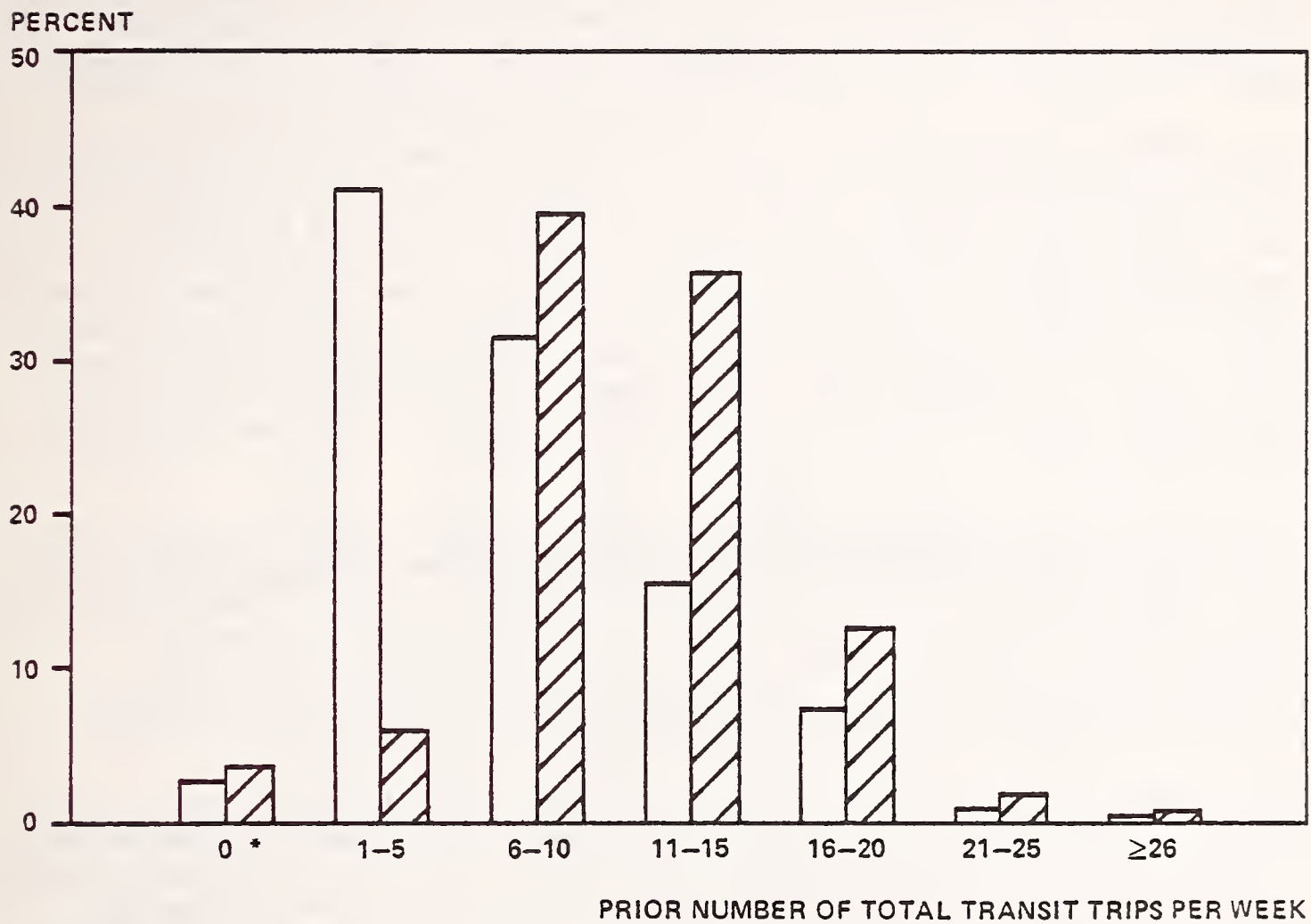
SOURCE: On-board Bus Survey, May 1979.



FIGURE 2-8. CHANGE IN WORK TRANSIT TRIPS FOR CASH AND TRANSCARD INDIVIDUALS



SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-9. CHANGE IN NONWORK TRANSIT TRIPS FOR CASH AND TRANSCARD INDIVIDUALS



 Cash *79 out of 2182
 TransCard

SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-10. PRIOR NUMBER OF TRANSIT TRIPS FOR CASH AND TRANSCARD INDIVIDUALS

Figure 2-11 shows how the increase in the number of bus trips taken per week for work varies by age for cash and TransCard individuals. It is evident that young TransCard purchasers increased, on an absolute basis, the number of work trips per week taken by transit compared to older TransCard users. For the age group less than 16 years old only, this is due, in part, because these individuals tended to make fewer work trips per week compared to other age groups, before purchasing a pass. (Note that the only significant reduction in work transit trips made by cash users occurred for individuals age 65 and over.)

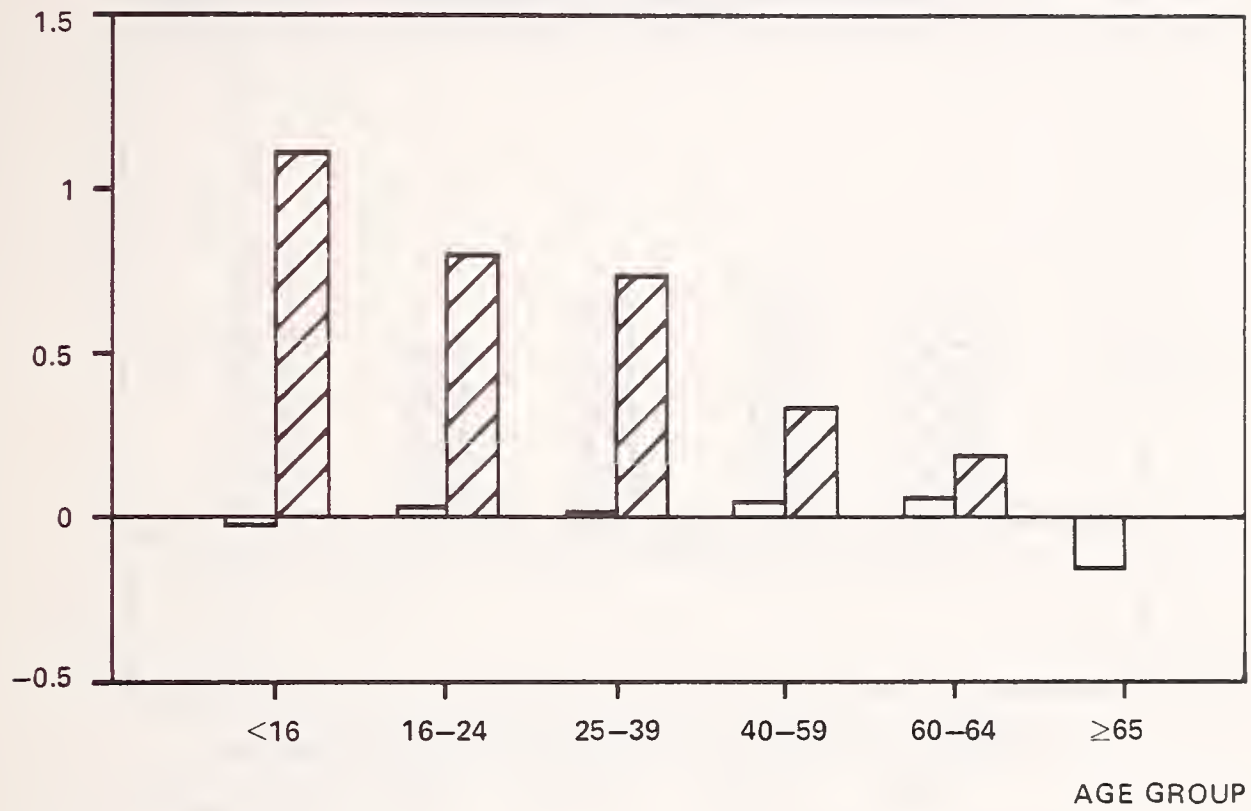
Two possible explanations for the relationship between age and change in transit travel behavior by TransCard purchasers are 1) that older individuals tend to have more regular or stable trip patterns compared to younger individuals or 2) that income, which may be correlated with age, is a determining factor in transit trip rate changes. However, Figure 2-12 shows that the change in the number of bus work trips per week is invariant with income. An F-test indicates that the means for TransCard users were not significantly different across income groups. The same was also true for cash users. Thus, this evidence rejects the second of the two hypotheses presented above.

Figure 2-13 depicts the change in the number of bus trips per week made to or from work by cash and TransCard users across sex and race categories. For TransCard users there is no difference in the mean number of additional trips made between white females and black females and only a very small, insignificant difference between white males and black males (t -test = -0.385). Thus, race is not a significant factor in the change in work transit trip rate for TransCard individuals.

With respect to gender, the results are mixed. The difference in the mean number of additional work transit trips between white female and white male TransCard users is not significant (t = -1.23), while the difference in means is significant (t = 2.62) between black male and black female TransCard users. Although the absolute difference is slightly larger between black males and females, the statistical significance is due primarily to the larger number of blacks in the sample.

The change in the mean number of work bus trips per week for cash users by sex and race is more peculiar. According to the bar graph in Figure 2-13, only white females exhibited a net decrease in the number of work bus trips per week. The three other groups all increased by about similar amounts the number of new bus work trips taken per week. The decrease in trips for white females is significantly different from the means for both white males and black females, and a F-test of the hypothesis that the means are the same for the four groups cannot be accepted.

MEAN CHANGE IN NUMBER OF BUS WORK TRIPS PER WEEK

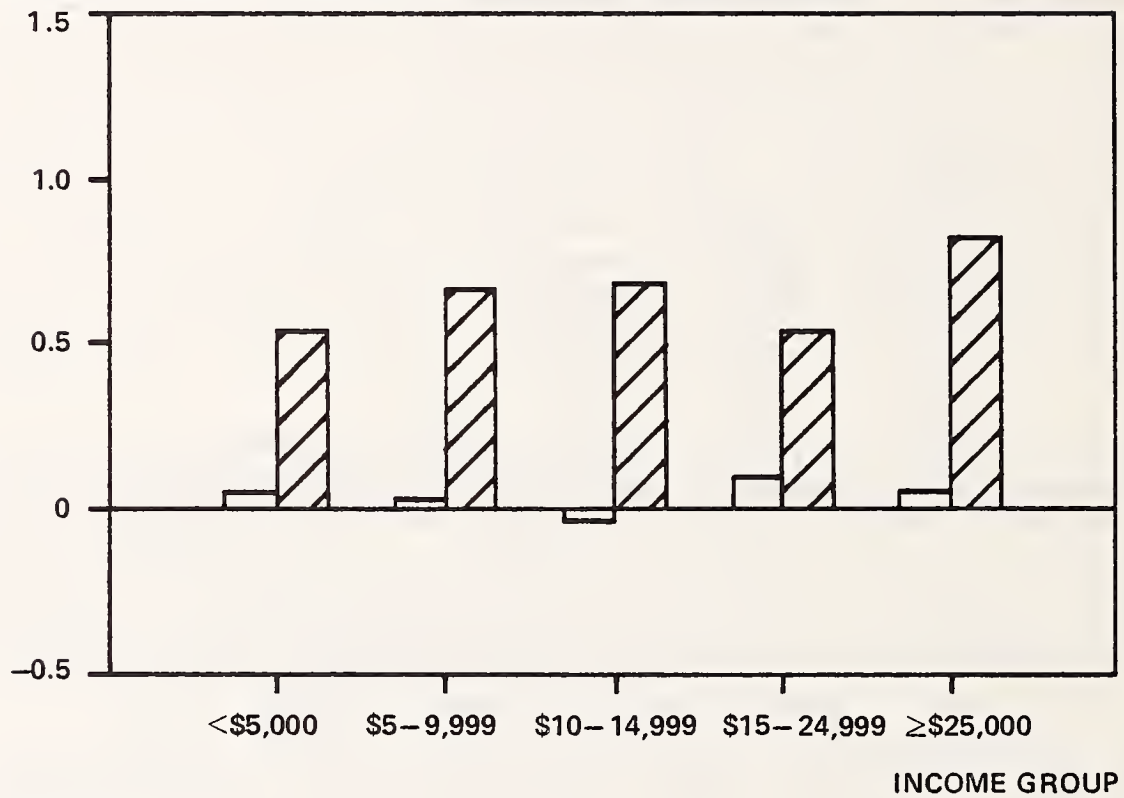


Cash
TransCard

SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-11. CHANGE IN WORK TRANSIT TRIPS FOR CASH AND TRANSCARD INDIVIDUALS BY AGE GROUP

MEAN CHANGE IN NUMBER OF BUS WORK TRIPS PER WEEK

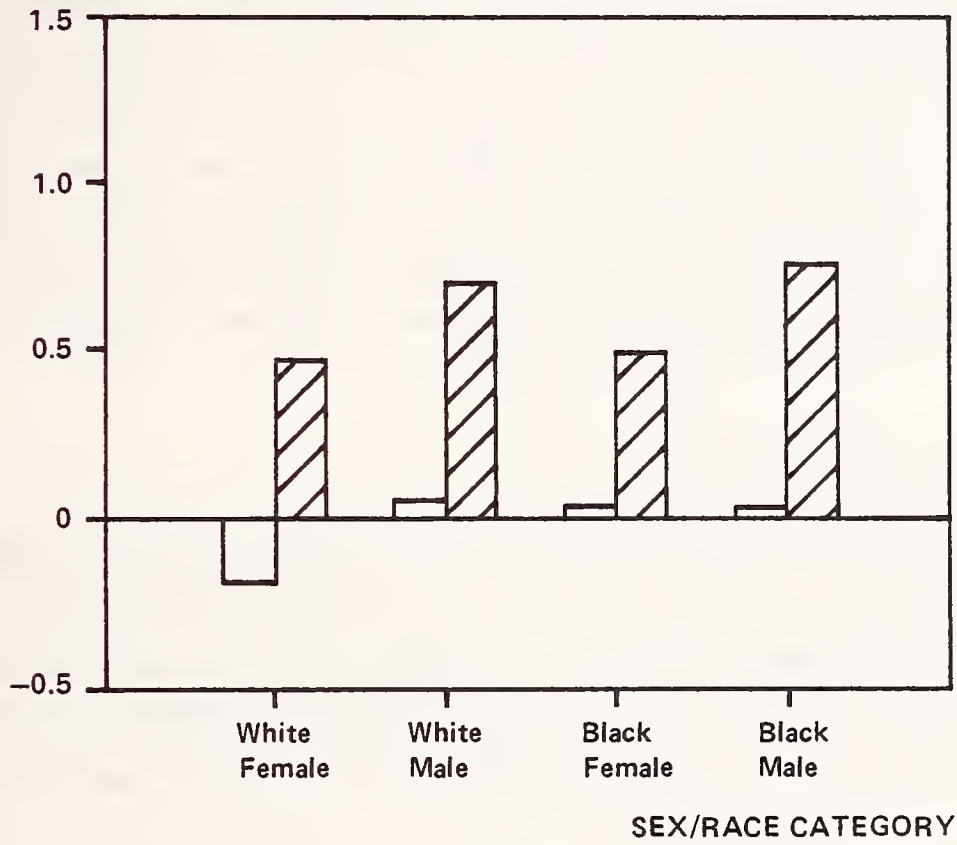


 Cash
 TransCard

SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-12. CHANGE IN WORK TRANSIT TRIPS FOR CASH AND TRANSCARD INDIVIDUALS BY INCOME GROUP

MEAN CHANGE IN NUMBER OF BUS WORK TRIPS PER WEEK



□ Cash
▨ TransCard

SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-13. CHANGE IN WORK TRANSIT TRIPS FOR CASH AND TRANSCARD INDIVIDUALS BY SEX AND RACE CATEGORIES

With respect to the change in the number of nonwork transit trips made by TransCard individuals, Figure 2-14 illustrates a similar pattern across race categories that was observed for work trips. In particular, there is a small, insignificant difference between the means for white and black females and between white and black males. With respect to sex, however, black male TransCard users increased nonwork trips by about 1.5 trips per week, whereas black females increased nonwork transit trips by less than 1 trip per week ($t = -3.61$). Conversely, the difference in means between white male and white female TransCard users is not significant.

Figure 2-15 shows that an individual who purchased a TransCard and who had an automobile available made more new transit trips per week for work than those persons who did not have an auto available ($t = 2.0$). Basically, TransCard individuals without an auto available tended to take transit more often to begin with and consequently were less likely to make even more work trips by transit given an opportunity to do so (i.e., by buying a pass). However, as TransCard users without an auto available were not similarly constrained when it came to nonwork bus trips, Figure 2-16 shows that these individuals did make more additional trips per week for nonwork purposes compared to individuals that did have an auto available.

2.2.3 Why Purchase TransCard

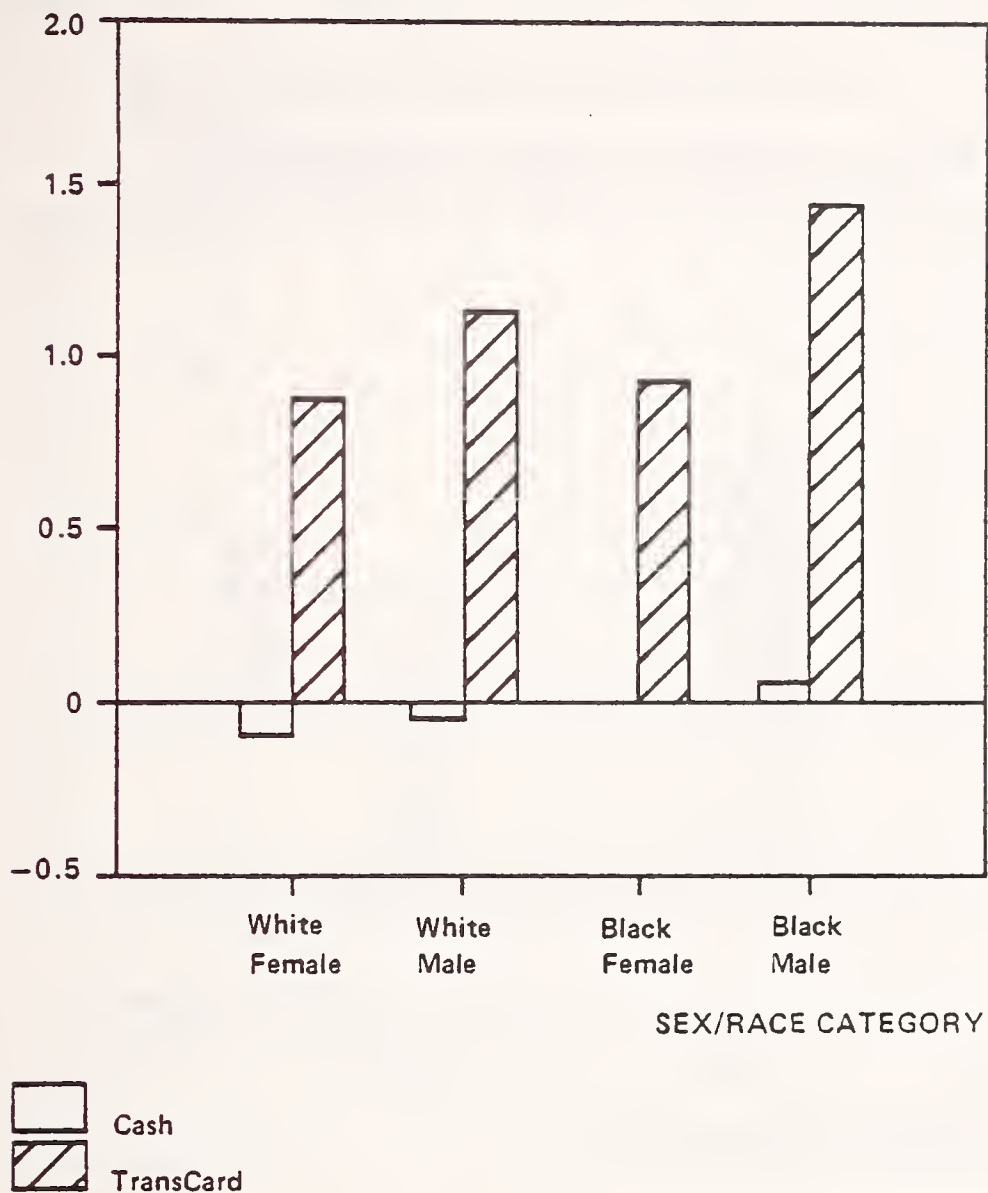
A number of studies have indicated that individuals purchase a monthly transit pass either for convenience reasons or to save money. More than likely, the combination of both factors is important and the relative importance between the two factors is probably a function of the number of transit trips an individual typically makes and the breakeven price of the pass. However, the data indicates that relatively few individuals purchase a pass and make less than the breakeven number of trips for the convenience of using a pass.

In addition to ranking the reasons why individuals purchase TransCard, we discuss in this section how the reasons vary by different socioeconomic characteristics. Information along these lines may be particularly useful in formulating marketing strategies for monthly transit passes.

Table 2-3 lists the first and second reasons that were given by TransCard individuals for why they purchased a pass. The most frequent response given was to save money (i.e., compared to the alternative of paying separate cash fares). This is a logical reason, since, as determined from Figure 2-7, about 70 percent of the individuals who have a TransCard make more than the breakeven number of bus trips per week. (About 95 percent of the TransCard users report making the same or more than the breakeven number of bus trips per week.)

Although the response "convenience, do not need cash fares" was stated by 28.4 percent of the individuals, many of the remaining reasons could be

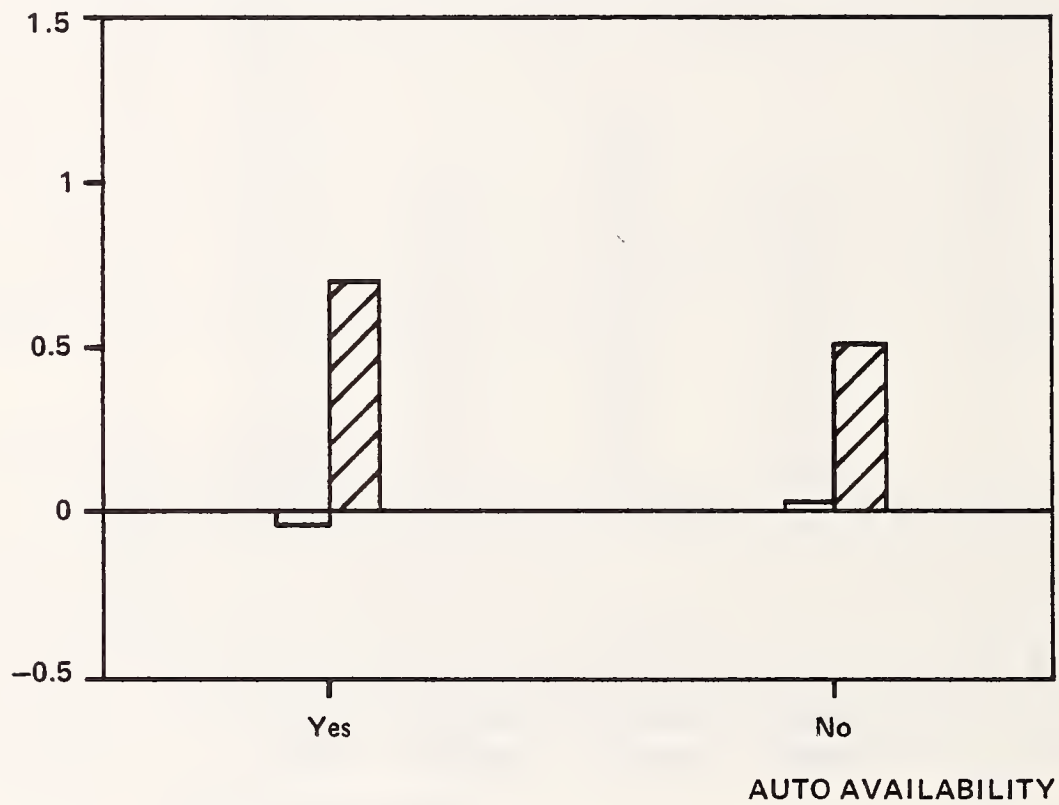
MEAN CHANGE IN NUMBER OF NONWORK BUS TRIPS PER WEEK



SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-14. CHANGE IN NONWORK TRANSIT TRIPS FOR CASH AND TRASCARD INDIVIDUALS BY SEX AND RACE CATEGORIES

MEAN CHANGE IN NUMBER OF BUS WORK TRIPS PER WEEK

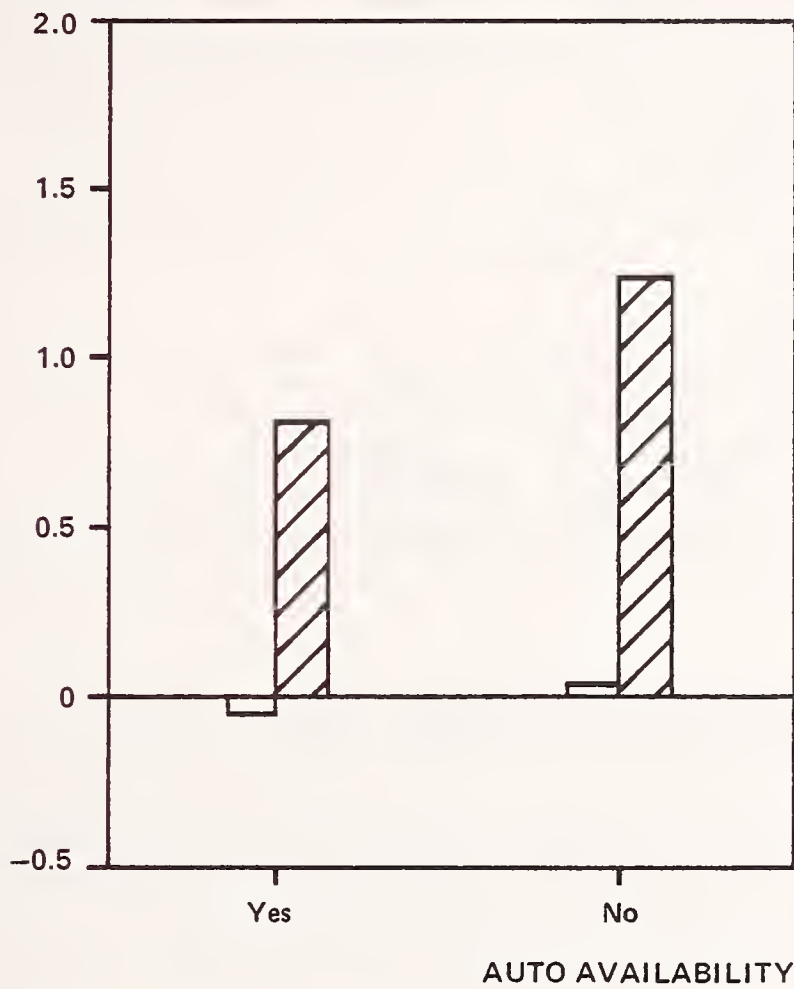


 Cash
 Transcard

SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-15. CHANGE IN WORK TRANSIT TRIPS FOR CASH AND TRANSCARD INDIVIDUALS BY AUTO AVAILABILITY

MEAN CHANGE IN NUMBER OF NONWORK BUS TRIPS PER WEEK



Cash
TransCard

SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-16. CHANGE IN NONWORK TRANSIT TRIPS FOR CASH AND TRASCARD INDIVIDUALS BY AUTO AVAILABILITY

TABLE 2-3. WHY DID YOU BUY A TRANSCARD

<u>Reason Stated</u>	<u>% Responding First Reason</u>	<u>% Responding Second Reason</u>
Save money	56.2	16.9
Convenience/no need for cash	28.4	43.8
Allows stopovers	4.8	4.7
Easier/faster to board bus	4.5	9.8
Pay once a month	2.3	7.5
Easier to transfer	1.9	12.7
Other	1.7	2.1
Offset fare increase	<u>0.2</u>	<u>2.5</u>
	100.0	100.0

SOURCE: Before On-board bus survey (May 1979).

encompassed under a broad definition of convenience (i.e., easier to board bus, pay once a month, easier to transfer). Thus, "convenience" is certainly a popular (second) reason for buying a pass.

Purchasing a pass to offset the impact of the fare increase was given as a reason by very few of the respondents. Although this reason might be considered a subset of saving money, it apparently has little salience in its own right.

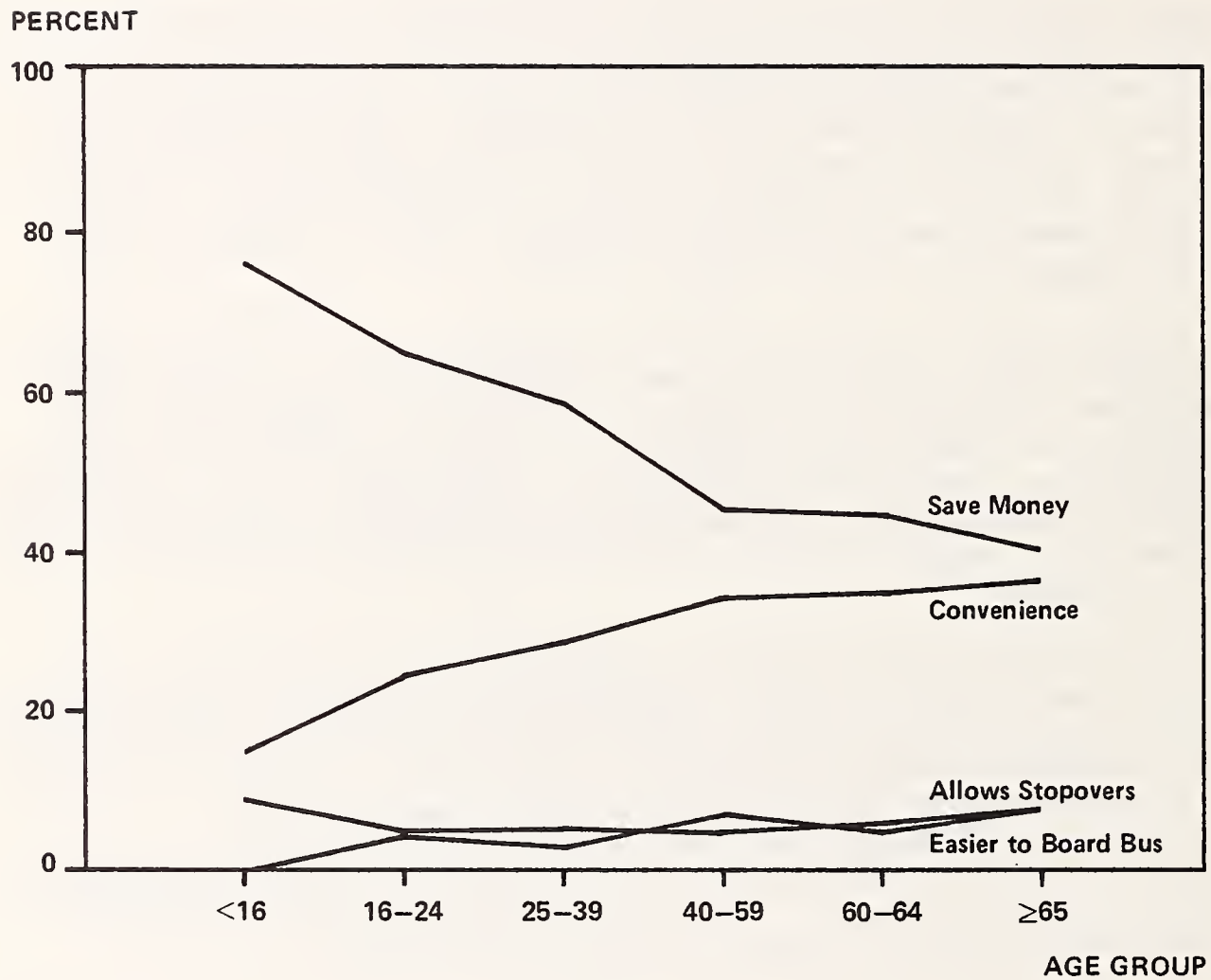
The response "easier to transfer" was far from being a primary reason for the decision to purchase a pass. However, it tied for third as the most frequent response for the second reason to purchase a pass. As this answer may be another way to gauge qualitatively the intramodal integration aspects of a monthly pass, it could be inferred that while the driving force in purchasing a pass is not due to its intramodal integration characteristics, it is considered by some to be an ancillary (fringe) benefit of having a pass. Section 2.4 examines this issue in more detail.

How the first reason that was given for purchasing a pass varies by age is shown in Figure 2-17. "Save money" ranks first with all age groups and is the predominant reason given by younger individuals. "Save money" and "convenience" are almost mirror images; as convenience becomes increasingly important with age, saving money declines in importance. "Allows stopovers" is almost uniformly constant across age groups except for individuals less than 16 year old. However, this may be due to the small cell size ($n = 28$) for this age group.

Figure 2-18 illustrates how the first reason given for purchasing a pass varies by income categories. It is interesting to note that for the lowest three income groups the responses given are fairly uniform -- "save money" being the predominant reason followed by "convenience." However, as income increases, "convenience" becomes a more frequent response and correspondingly, "save money" declines in importance. In fact, of all the socioeconomic variables examined, the only instance in which "convenience" was given as the most frequent response for buying a TransCard was for individuals with household incomes in excess of \$25,000.

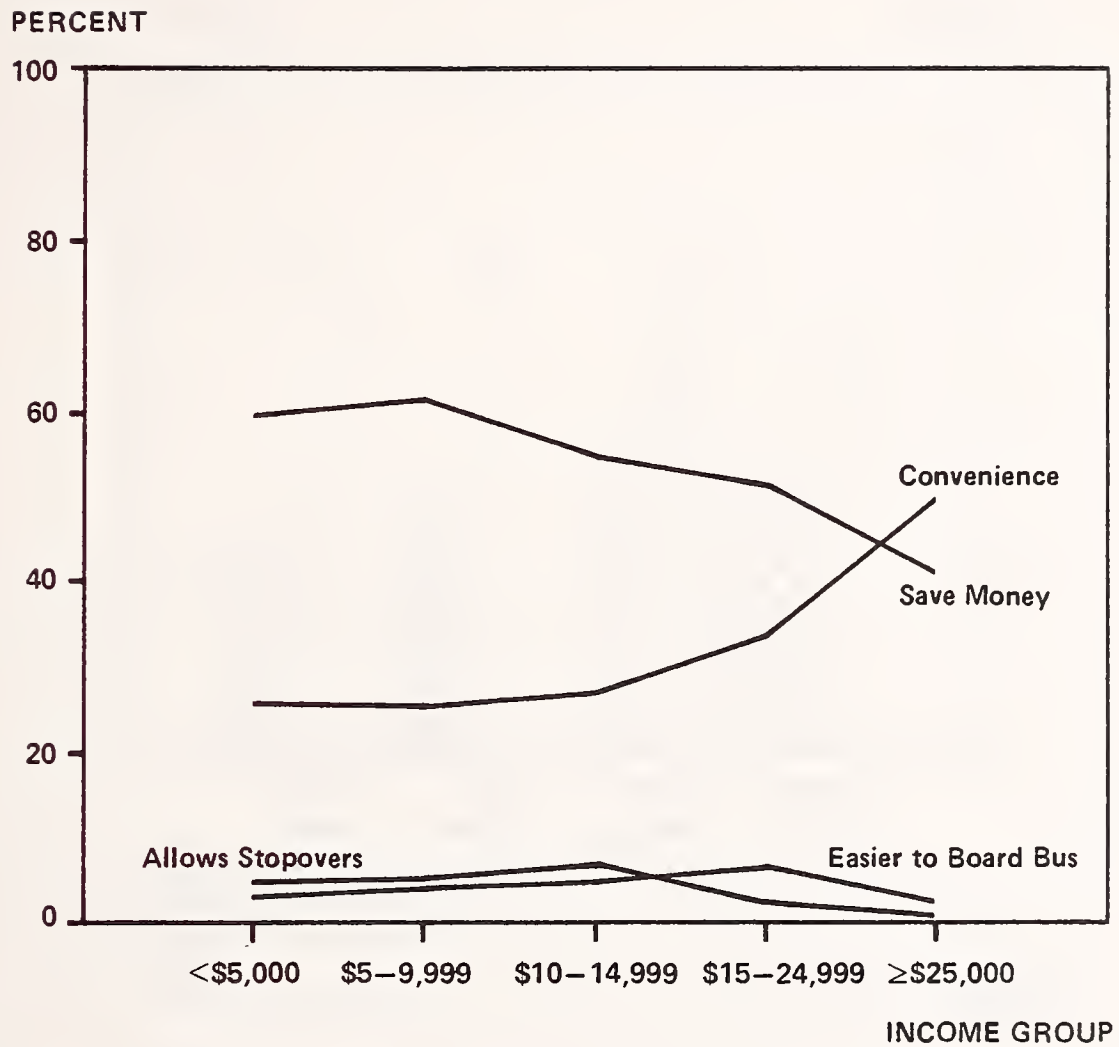
How the two dominant responses, "save money" and "convenience", vary by the four primary sex/race categories is shown in Figure 2-19. The figure indicates that race rather than sex is the more discriminating factor in the reasons given for purchasing a TransCard. "Save money" is a relatively more frequent response given by blacks.

As depicted in Figure 2-20, TransCard users without an auto available for use responded that "save money" was a relatively more important reason in buying a pass compared to TransCard users with an auto available. As one would suspect, individuals without an auto available are likely to have lower incomes, and as was observed in Figure 2-18, individuals with lower incomes gave a high ranking to "save money."



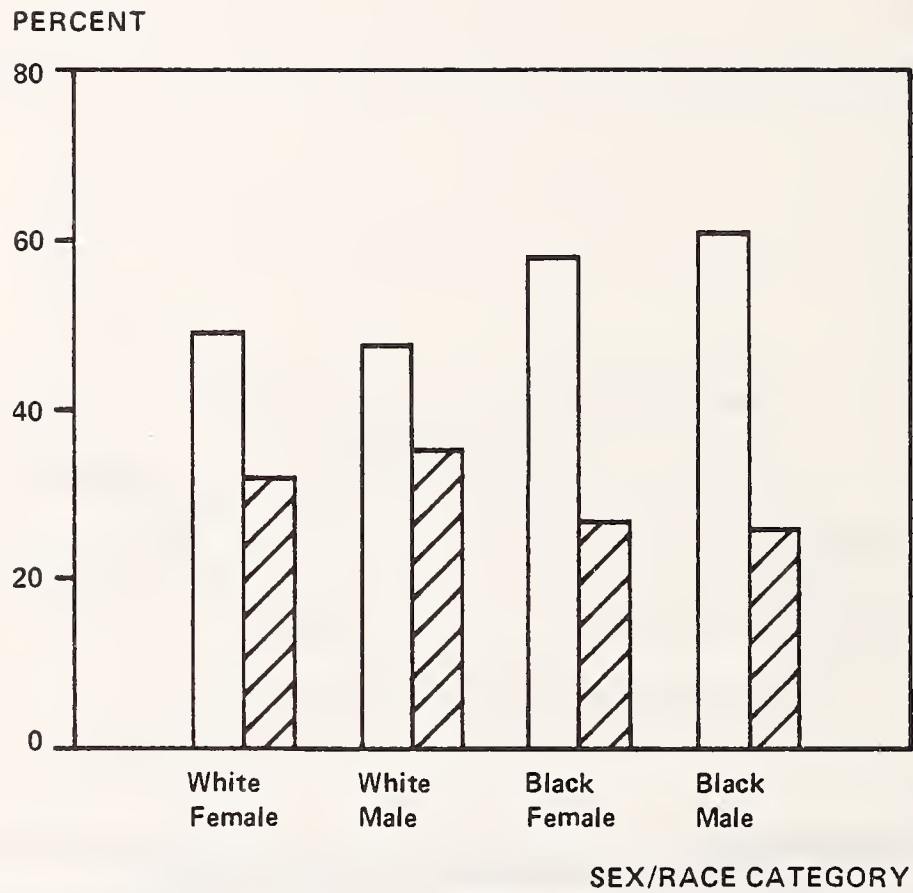
SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-17. FIRST REASON GIVEN BY TRANSCARD HOLDERS FOR PURCHASING A PASS BY AGE CATEGORY



SOURCE: On-board Bus Survey, May 1979.

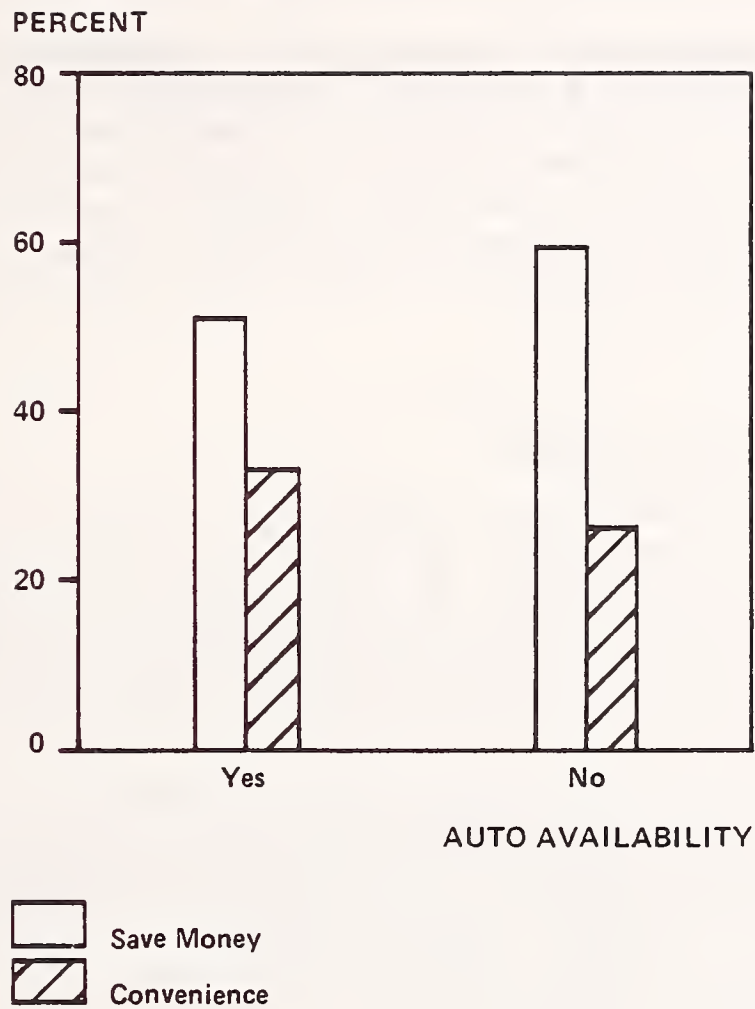
FIGURE 2-18. FIRST REASON GIVEN BY TRANSCARD HOLDERS FOR PURCHASING A PASS BY INCOME



 Save Money
 Convenience

SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-19. FIRST REASON GIVEN BY TRANSCARD HOLDERS FOR PURCHASING A PASS BY SEX AND RACE CATEGORIES



SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-20. FIRST REASON GIVEN BY TRANSCARD HOLDERS FOR PURCHASING A PASS BY AUTO AVAILABILITY

Figure 2-21 shows the relationship between the number of total bus trips taken per week before TransCard was available and the first reason given for purchasing a TransCard. As might be expected, "save money" becomes more important as an individual's transit trip frequency increases. Conversely, according to the mirror-image rule, "convenience" was favored slightly more often by individuals who made fewer transit trips per week. (This is not a simple linear relationship, however. In particular, the two lines are closest together in the 6 to 10 trips per week category which likely includes many individuals who simply use a pass to travel to and from work.)

While transit trip frequencies that exceed the breakeven mark seem to be a prerequisite for purchasing a TransCard, socioeconomic traits appear to have a stronger relationship to the underlying reasons given for purchasing a pass than does transit trip frequency alone. In general, while all market segments (except those with incomes over \$25,000) gave "save money" as the main reason for buying a TransCard, older, higher income, and white individuals have a greater tendency to list "convenience" as an important factor.

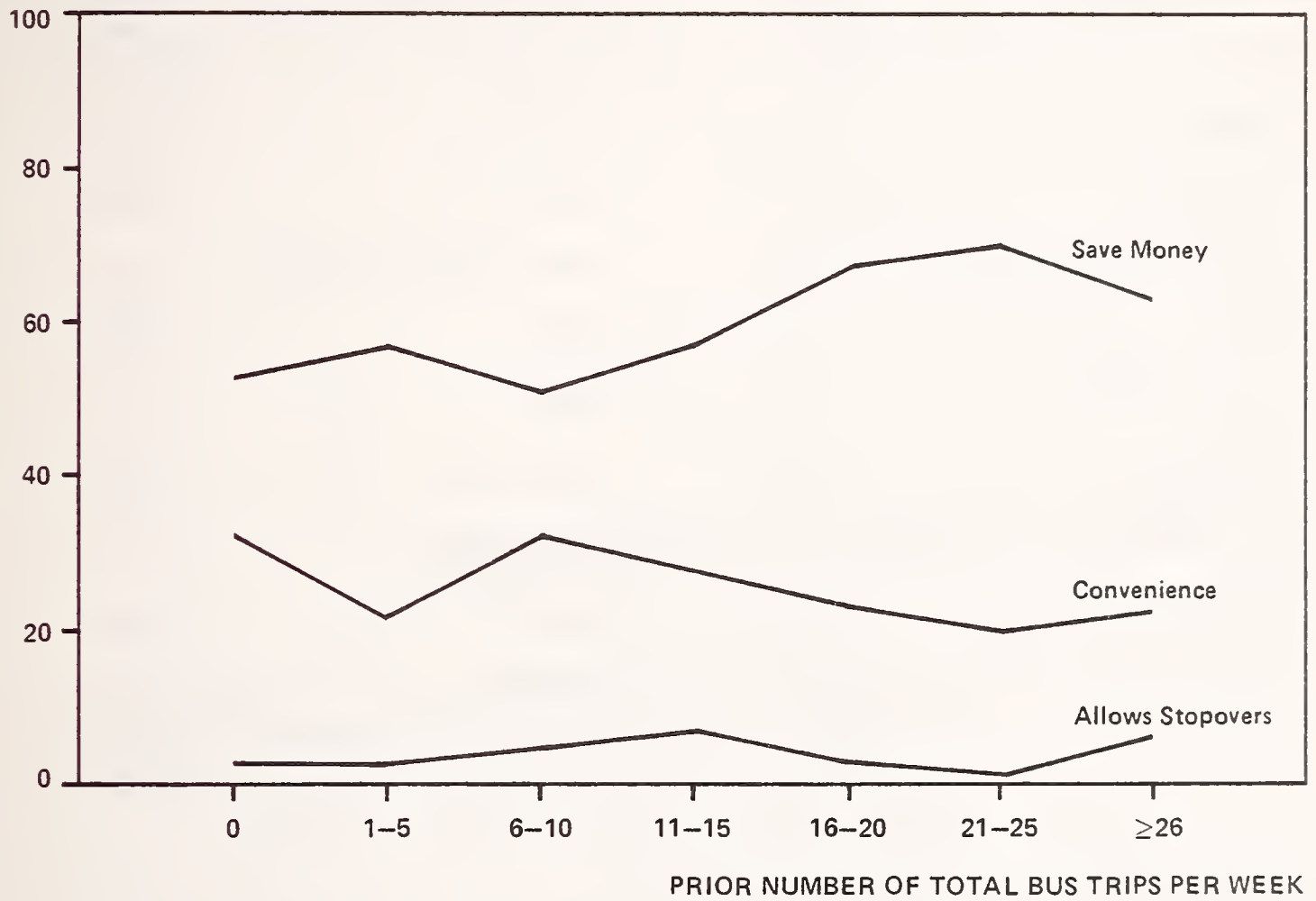
2.2.4 How Learned About TransCard

In publicizing the availability of TransCard, a variety of advertising approaches and mediums were used. By examining how individuals first became aware of TransCard, it is possible to assess the effectiveness of different approaches both in general terms, and with respect to specific market segments. Such information can be used to make decisions about the cost effectiveness of various advertising approaches to be used in the future.

Table 2-4 ranks how cash and TransCard users responded to the question concerning how they first learned about the availability of TransCard. Rider's Digest, a biweekly information bulletin distributed free onboard MARTA buses, was the most popular source for both cash and TransCard individuals. It was considerably more important for TransCard users who, of course, tend to be more frequent transit users. Similarly, "bus poster" was the second most frequent response given by TransCard users. "TV" and "a friend" were relatively more important sources of information among cash users. The frequency of other responses were generally similar between the two groups.

Only the four major sources of information are presented in Figures 2-22 through 2-24 since the other responses are fairly minor. (In some instances, however, the outlying categories in these figures should be interpreted cautiously because of the possibility of small cell frequencies.) These figures present the responses of TransCard users only. Corresponding figures for cash users, not presented here, reflect closely the information in Table 2-4 in that Rider's Digest is the main source of information although it lacks the predominance that it has among TransCard users.

PERCENT



SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-21. FIRST REASON GIVEN BY TRANSCARD HOLDERS FOR PURCHASING PASS BY PRIOR NUMBER OF TOTAL TRANSIT TRIPS PER WEEK

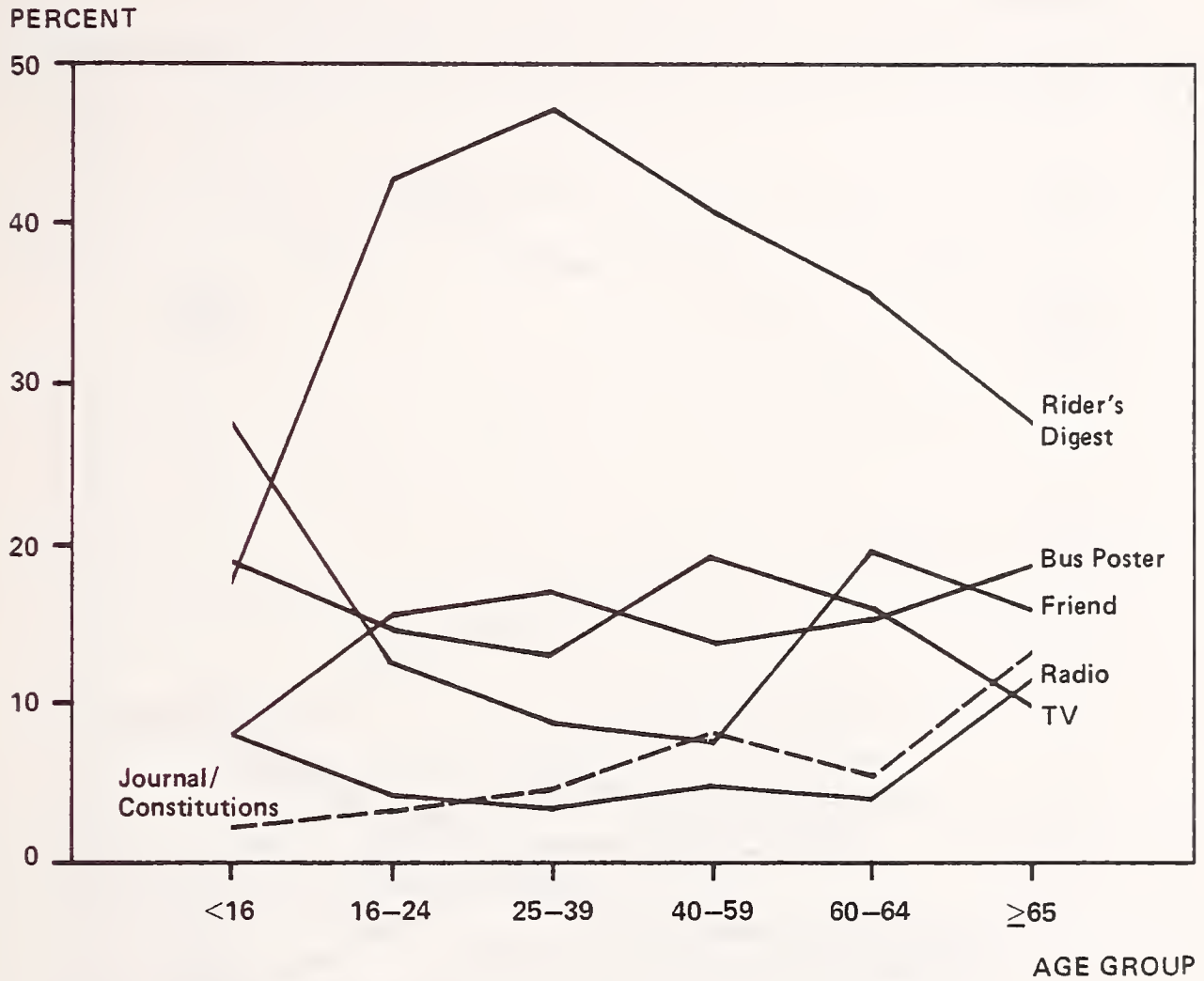
TABLE 2-4. HOW DID YOU LEARN ABOUT TRANSCARD

<u>Cash Users</u>		<u>TransCard Users</u>	
<u>Response</u>	<u>% Responding</u>	<u>Response</u>	<u>% Responding</u>
Rider's Digest	27.8	Rider's Digest	42.6
TV	22.0	Bus poster	15.1
Friend	16.8	TV	15.0
Bus poster	13.1	Friend	10.6
Journal/Constitution	6.9	Journal/Constitution	5.0
Radio	4.9	Radio	4.4
Other	3.3	Other	3.1
Passenger	2.0	Other paper	1.7
Other paper	1.8	Bus operator	1.1
Relative	1.4	Relative	1.0
Bus operator	<u>0.5</u>	Passenger	<u>0.4</u>
	100.0		100.0

SOURCE: Before On-Board bus survey (May 1979).

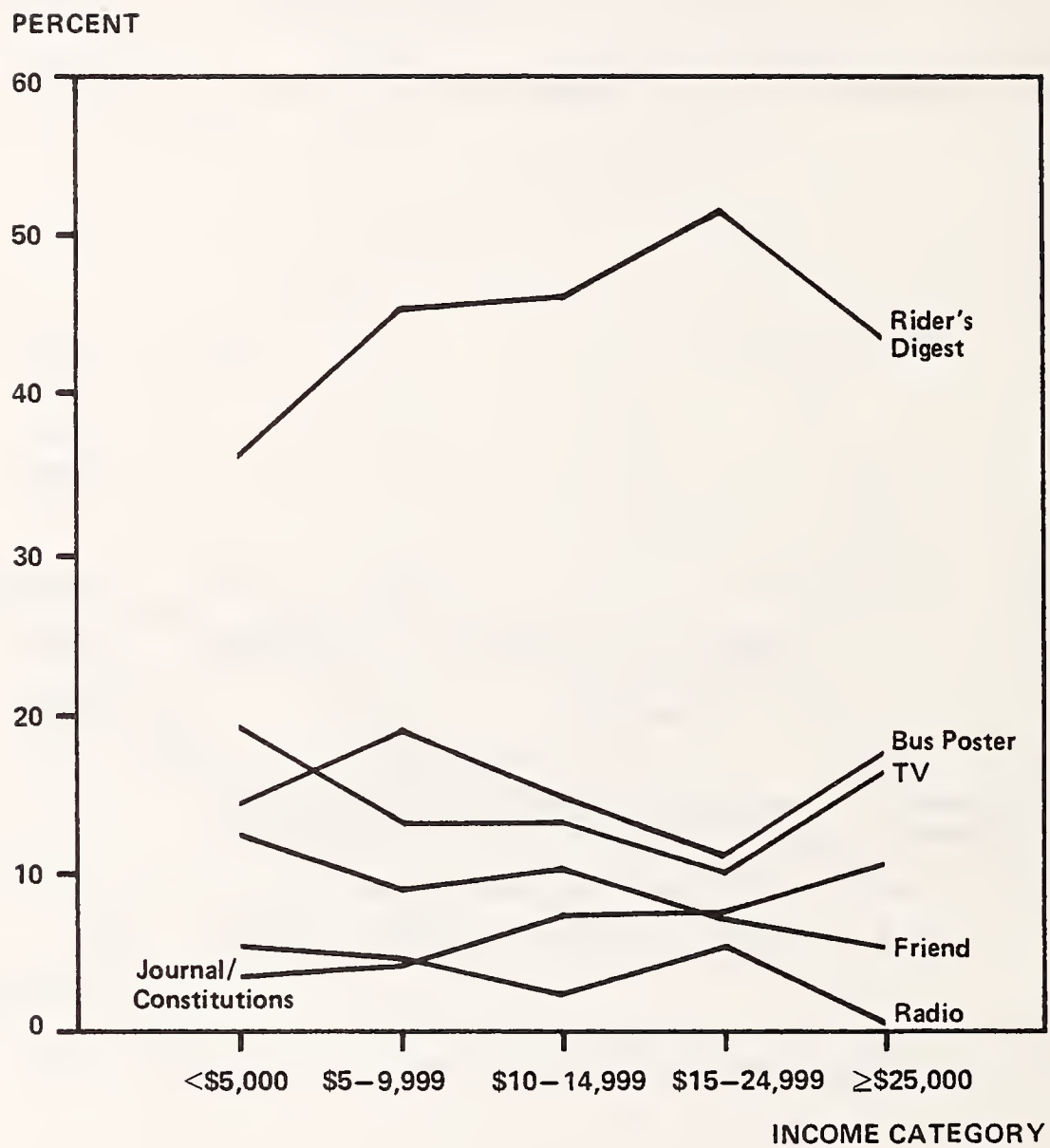
Figure 23

WHERE TRANSCARD USERS LEARNED ABOUT TRANSCARD BY AGE



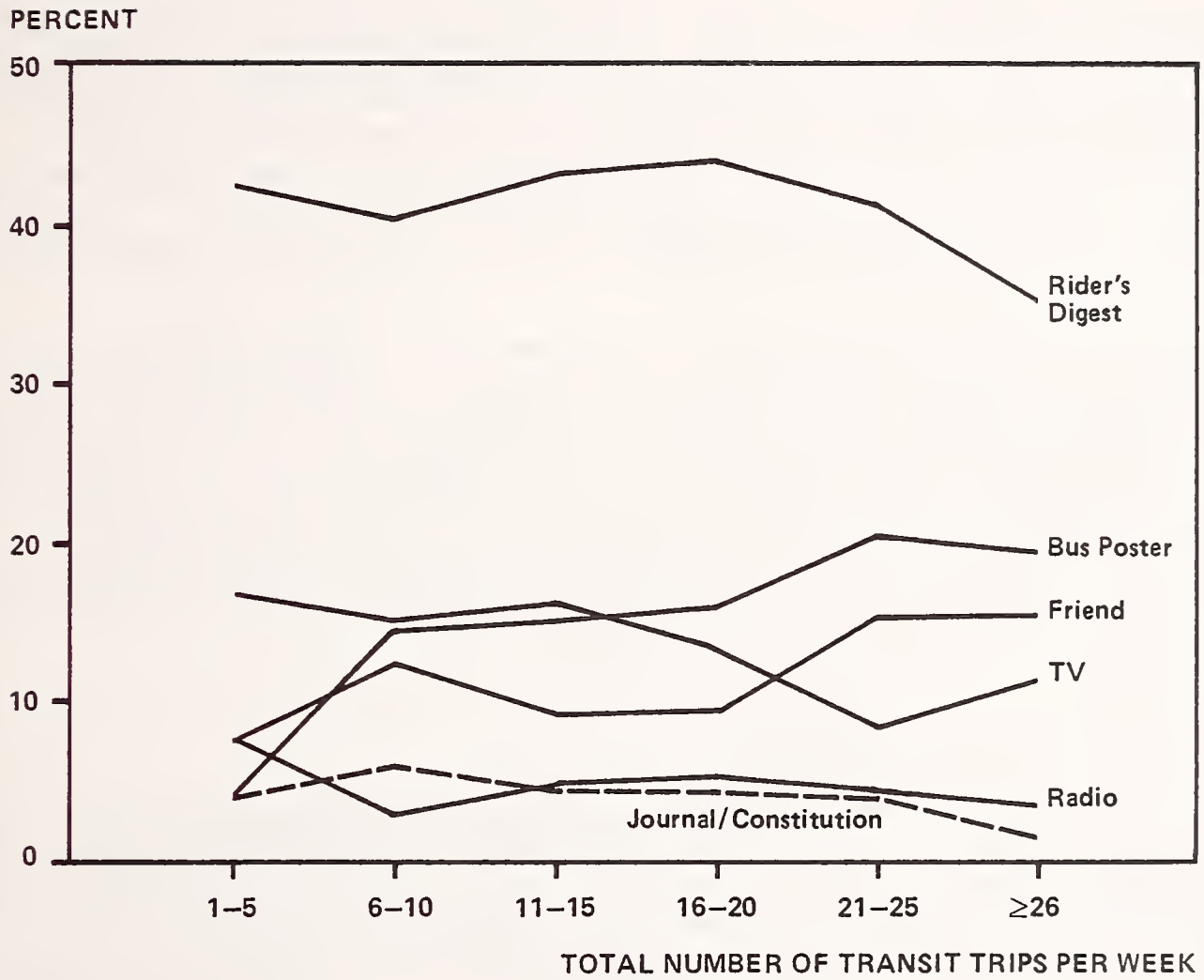
SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-22. WHERE TRANSCARD USERS LEARNED ABOUT TRANSCARD BY AGE



SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-23. HOW TRANSCARD USERS LEARNED ABOUT TRANSCARD BY INCOME CATEGORIES



SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-24. HOW TRANSCARD USERS LEARNED ABOUT TRANSCARD BY TOTAL TRANSIT TRIP FREQUENCY

Figure 2-22 shows how the responses vary by age group. Basically, Rider's Digest was the most frequent source cited across all age groups, although it becomes less important as age increases. (For those under 16 years of age the number of observations may be too small to assure accuracy.) "TV" and "bus posters" have similar and fairly constant percentages across the middle age groups. A mild positive correlation appears to exist between the response Journal/Constitution (which are the local newspapers) and age, especially for individuals over 65. Radio is fairly uniform across all age groups except for those under 16, and as with the newspaper, for those over 65.

Tabulations of responses by income categories reveal less variability in the reasons given for purchasing a pass. As displayed in Figure 2-23, Rider's Digest was an overwhelming response across all income categories except for a modest decline for those earning less than \$5,000 per year. For these individuals, "TV" and "a friend" were relatively more frequent sources. Almost all other sources appear stable across income, except for a noticeable increase in the Journal/Constitution newspapers for those in the \$25,000+ income group.

Across all trip frequencies Figure 2-24 shows that Rider's Digest is the predominant source of information about TransCard. Both "bus poster" and "a friend" become slightly more important as trip frequency increases, while "TV" decreases slightly in importance. Of course, "bus poster," which can only be read while riding the bus, is cited infrequently by individuals who make few weekly trips by transit. Oddly enough, however, this same observation does not apply to Rider's Digest, which is also only available on board a bus. (Possibly this is because an infrequent rider picks up a copy of the Digest nearly as often as a frequent rider.)

2.2.5 Why Not Purchase TransCard

Just as it is useful from a marketing perspective to understand why individuals purchase a pass, it is also useful to examine why cash users do not purchase a pass. Table 2-5 lists the reasons that cash users gave for not purchasing a TransCard. As has been suggested previously, a low frequency of transit use is the main reason given for not buying a TransCard. Over 60 percent of the individuals who pay with cash responded that they "Don't Ride MARTA Enough." This is by far the predominant response with "no opinion" and "other" ranking second and third.

The primary response for the entire sample, "Don't Ride MARTA Enough," is cited more frequently by individuals who had an automobile available compared to those who do not have an auto available (i.e., 74 vs 50 percent

TABLE 2-5. FOR WHAT REASONS HAVE YOU NOT BOUGHT TRANSCARD
(Cash Users Only)

<u>Reason</u>	<u>Percent</u>
Don't ride MARTA enough	61.64
No opinion	12.13
Other	7.06
High initial cost	7.05
Haven't taken time	4.00
Outlets aren't convenient	3.36
Don't know where to buy it	2.53
I'll lose it	<u>2.24</u>
	100.0

SOURCE: Before On-board bus survey (May 1979).

respectively). This observation is logical as the correlation between auto availability and transit trip frequency is usually quite strong. Primarily because the response "Don't Ride MARTA Enough" is not as relevant to individuals without an auto available, all the other responses given by this group increased in importance compared to what was observed for individuals with an auto available.

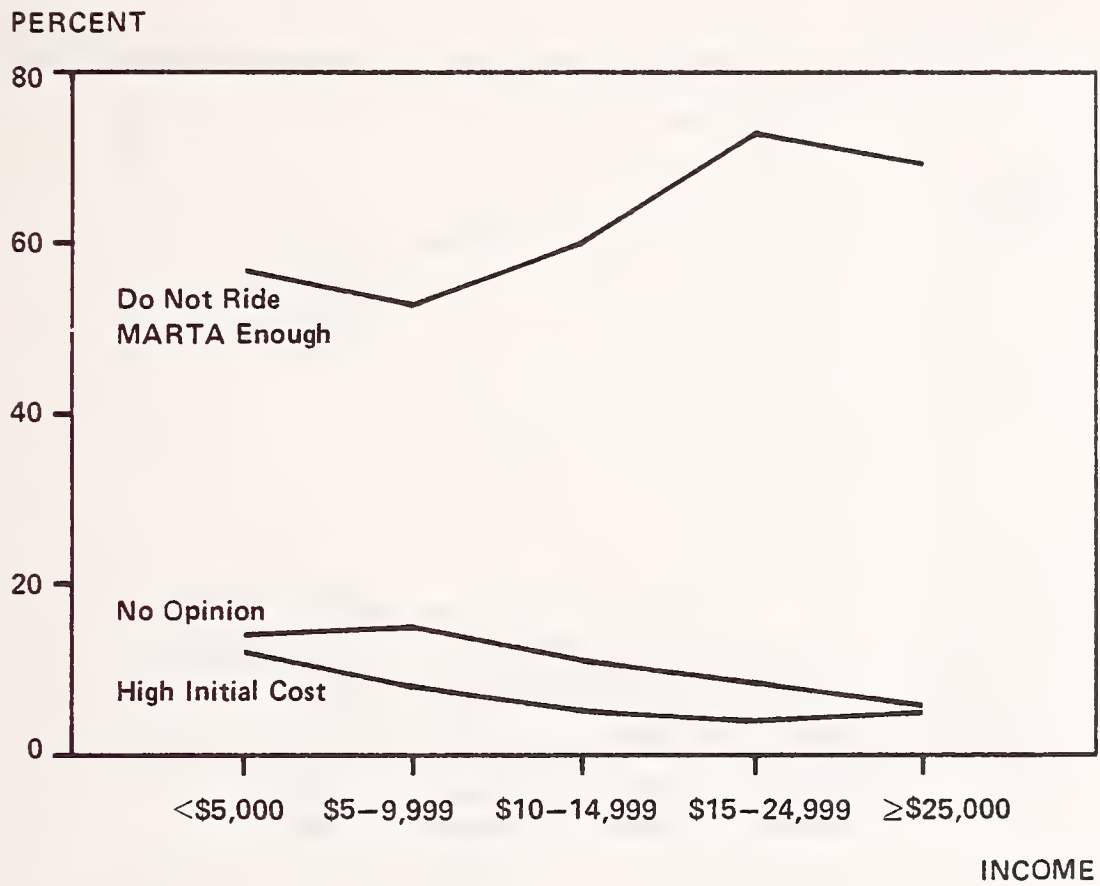
The distribution of responses by income categories, shown in Figure 2-25, reveals a modest positive relationship between income and "Don't Ride MARTA Enough." Conversely, "High Initial Cost" is a relatively more frequent response for low income individuals and declines in importance as income increases. This may be one reason why some individuals, who are very frequent transit users, continue to pay with cash fares (see Figure 2-10). To an extent this is confirmed by MARTA's observation that a fair number of passes are purchased well into the middle of the sale month, presumably because only at that time has the individual accumulated the "front end" funds for the price of the pass. If the purchaser is a frequent transit user, he or she will still save money, even though the pass will not be used for the entire month.

It is interesting to note that the "no opinion" response declines with rising income, a finding which tends to distort responses in the lower income groups (similar in concept to the nonrandom return bias). As another example of this, Figure 2-26 presents the responses to this question disaggregated by sex and race categories. At first glance there appears to be a significant variation in the "Don't Ride MARTA Enough" answers across the four groups. However, over one-half of this difference is due to the higher response of "no opinion" given as an answer by some groups. Figure 2-27 displays how the responses vary by age. As before, "Don't Ride MARTA Enough" is the dominant answer, but it too is distorted somewhat by the fewer "no opinion" answers given by people age 65 and over.

2.2.6 Does Pass Purchase Offset Effects of Fare Increase

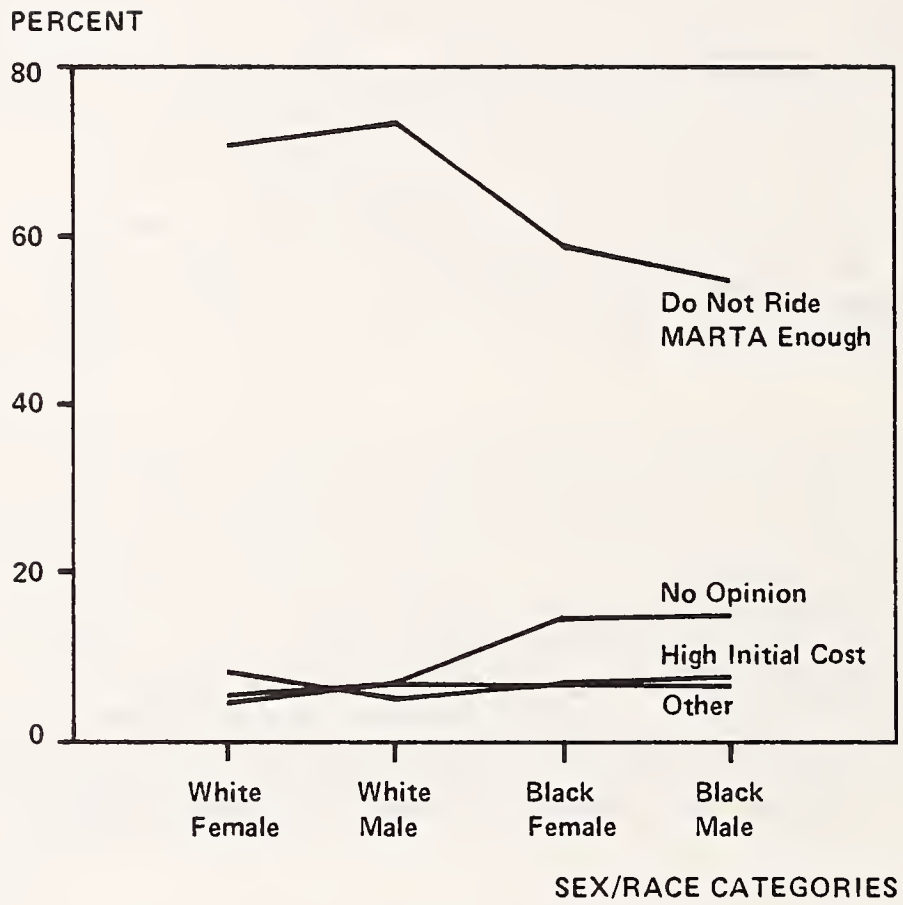
One of the objectives of introducing a monthly transit pass concurrently with a fare increase is to help offset the impacts of such an increase on frequent users of the system. One would expect, therefore, that the likelihood of buying a pass would increase with transit trip frequency. However, as shown in Figure 2-28,* the proportion of transit boarders within a given transit trip rate (i.e., frequency) category does not increase monotonically with transit trip rate. Thus, heavy transit users have not switched to the pass at the (increasing) rate one would expect in order to lessen the financial impact of the fare increase.

*Figure 2-28 is a normalization of Figure 2-10 by trip rate and sampling rate.



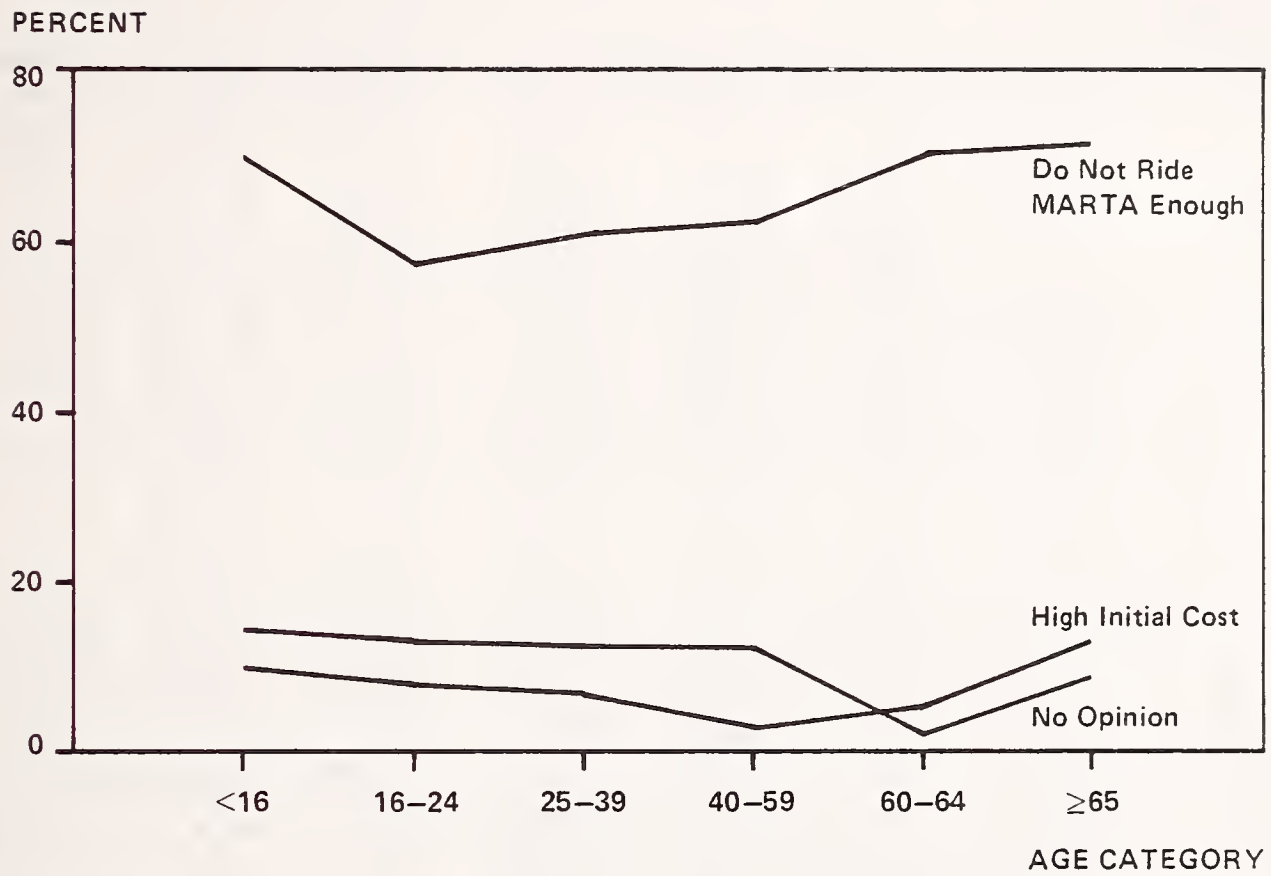
SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-25. WHY CASH USERS DO NOT BUY TRANSCARD BY INCOME CATEGORIES



SOURCE: On-board Bus Survey, May 1979.

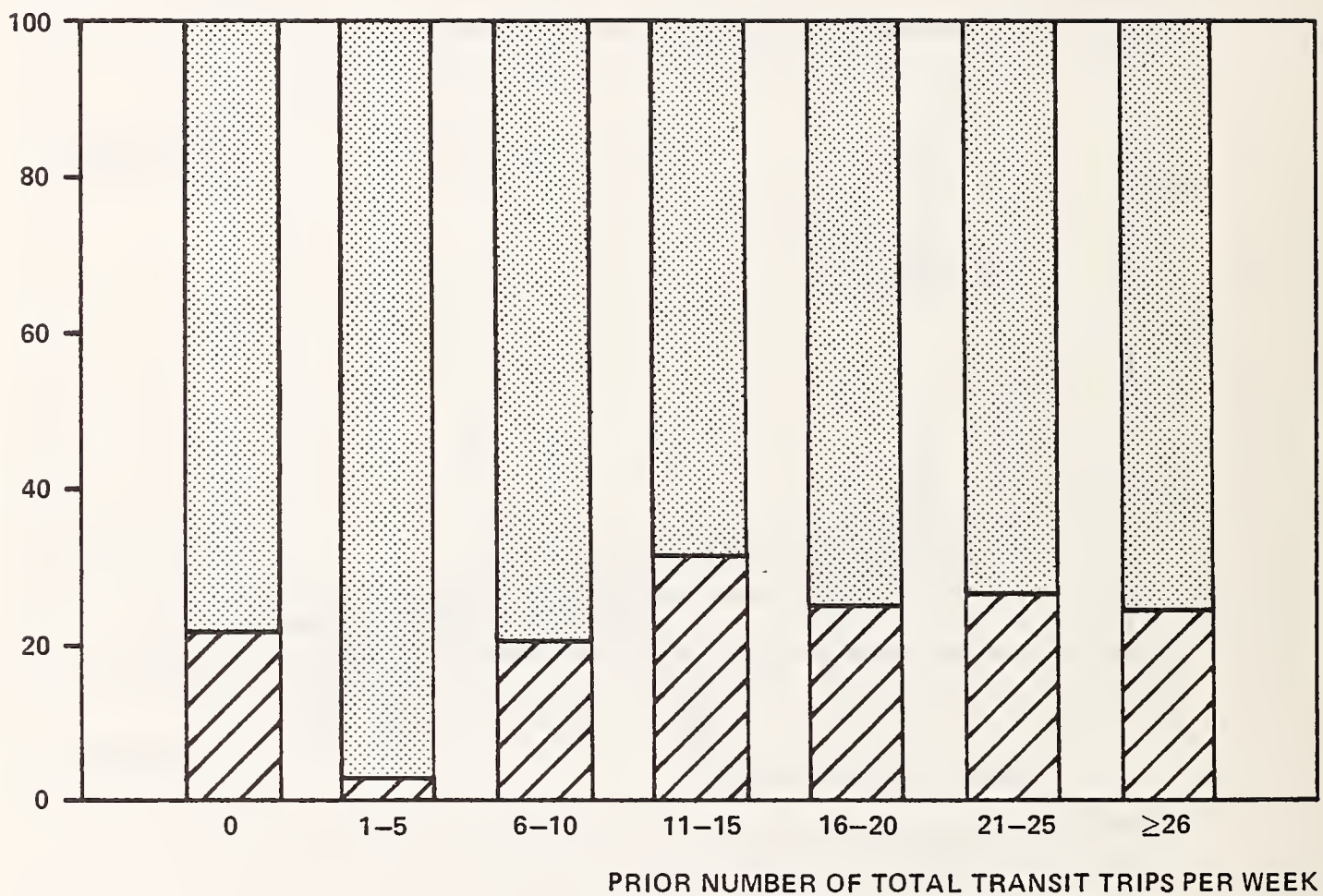
FIGURE 2-26. CASH USERS' MAIN REASON FOR NOT BUYING TRANSCARD BY SEX AND RACE CATEGORIES



SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-27. CASH USERS' MAIN REASON FOR NOT BUYING TRANSCARD BY AGE CATEGORIES

PERCENT



SOURCE: On-board Bus Survey, May 1979.

FIGURE 2-28. PERCENT OF TRANSIT USERS WHO BUY TRANSCARD BY PRIOR NUMBER OF TRANSIT TRIPS PER WEEK

Tending to confirm this notion is the observation made in Section 2.2.3 that very few TransCard users stated that they purchased a pass to offset the impact of the fare increase.

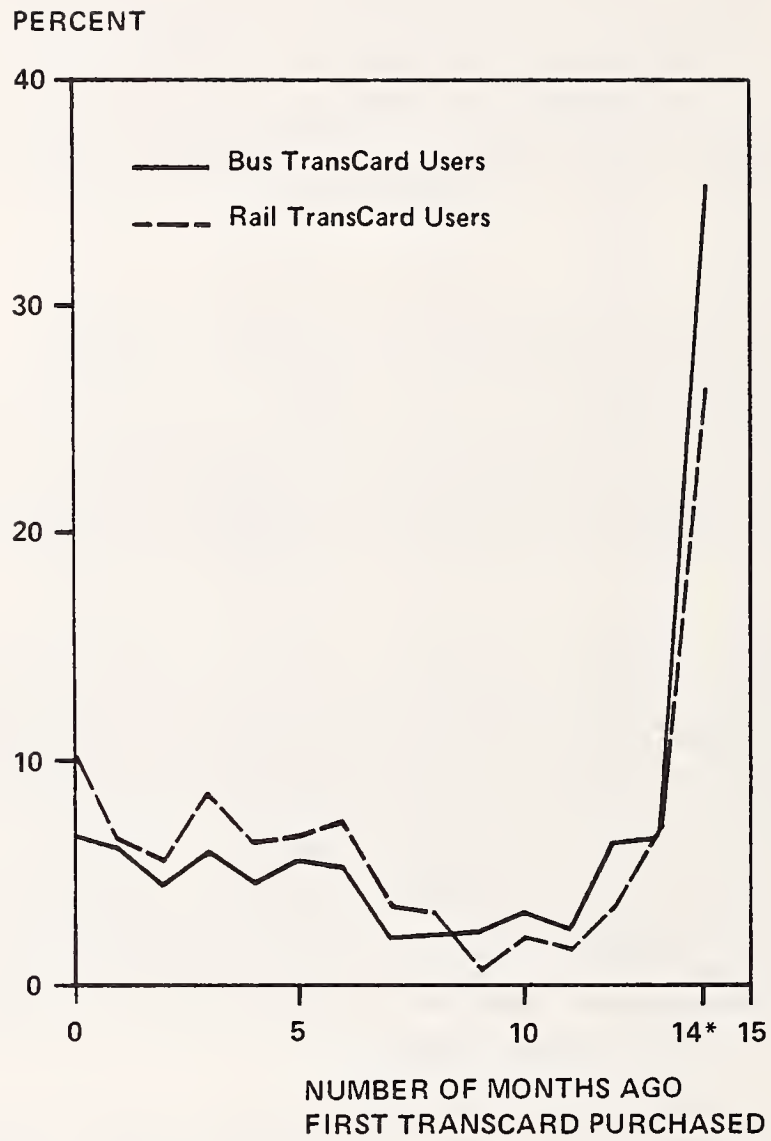
Another way to address this issue is to ask, what would have been the change in travel behavior of pass users if TransCard was not introduced at the time the fare was increased? The best evidence of this -- from the behavior of present cash users -- is that the mean change in transit trip frequency would be near zero. (Of course, the argument could be made that those individuals who were truly interested in minimizing the impact of the fare increase, bought a pass, and therefore would not be represented in the behavior of cash users.) However, as discussed in Section 2.3.2, those individuals who did buy a TransCard were shielded from the full impact of the fare increase since the pass price represents an upper limit on the monthly cost of using transit.

2.2.7 Frequency and Regularity of Purchasing TransCard

At the time the after bus and rail on-board surveys were conducted in May 1980, TransCards had been sold to the general public for 14 months. Sections 2.2.1 and 2.2.2 described the characteristics of some of the early pass buyers. This section examines the characteristics of long-term (i.e., 14 months) pass buyers, based on information from both bus and rail users.

Figure 2-29 shows the number of months ago that bus and rail TransCard individuals purchased their first pass. Not surprisingly, the most frequent response given was the month that TransCard was introduced. About 35 percent of bus and 26 percent of rail TransCard individuals purchased a TransCard the first month they went on sale. Alternatively, between 1 and 10 percent of the bus and TransCard users are first time purchasers in any given month. On average about 5 percent of TransCard individuals are new purchasers each month. Since aggregate pass sales grew an average of 2.25 percent per month in the 13 months from April 1979 until April 1980 (see Table 2-6), it appears that one existing pass user stopped buying a pass for every two new individuals who started buying a pass.

Rail TransCard users tend to include relatively more individuals who are recent pass buyers since the rail system started four months after passes were introduced, and is still maturing with respect to attracting individuals from nontransit modes. This distinction is also evident considering that 20 percent of rail TransCard individuals said they were not regular MARTA users before buying a pass compared to only 10 percent for bus TransCard individuals. (Normalizing by the effect of the still maturing rail mode would result in the two curves in Figure 2-29 having even more similar shapes which would imply that in a steady state system, bus and rail users are not very dissimilar with respect to how long ago a TransCard was initially purchased.)



*Introduction of TransCard – March 1, 1979.

SOURCE: After On-board Bus and Rail Surveys, May 1980.

FIGURE 2-29. NUMBER OF MONTHS AGO FIRST TRANSCARD WAS PURCHASED

TABLE 2-6. MONTHLY TRANSCARD SALES

<u>Month</u>	<u>Ridestore Sales</u>	<u>Total Pass Sales</u>
March 1979	--	13,580
April 1979	11,434	16,689
May 1979	12,692	18,027
June 1979	11,852	16,472
July 1979	12,386	17,199
August 1979	13,041	18,291
September 1979	12,336	17,173
October 1979	14,384	20,400
November 1979	14,189	20,848
December 1979	11,598	16,564
January 1980	13,226	19,238
February 1980	13,257	20,481
March 1980	14,727	21,165
April 1980	16,020	23,189
May 1980	15,641	22,864
June 1980	13,268	19,408
July 1980	--	Passes Recalled --
August 1980*	11,746	16,221
September 1980*	11,340	16,294
October 1980*	14,153	19,927

*In July 1980, TransCard price was increased from \$10.00 to \$17.00 when base fares went from 25¢ to 50¢; also a weekly pass priced at \$4.00 was introduced.

SOURCE: Metropolitan Atlanta Rapid Transit Authority.

As depicted in Figure 2-30 older pass users were more likely to have purchased a pass during the first month TransCards went on sale compared to younger users. Presumably, this is due to their more stable living, working and commutation patterns as compared to the relatively more mobile patterns of younger TransCard transit users. On an absolute basis, most new pass buyers are in the 16-39 age bracket.

By income groups there was no statistically significant difference (using an F-test) in the mean length of time since a pass was first purchased for either bus or rail TransCard users.

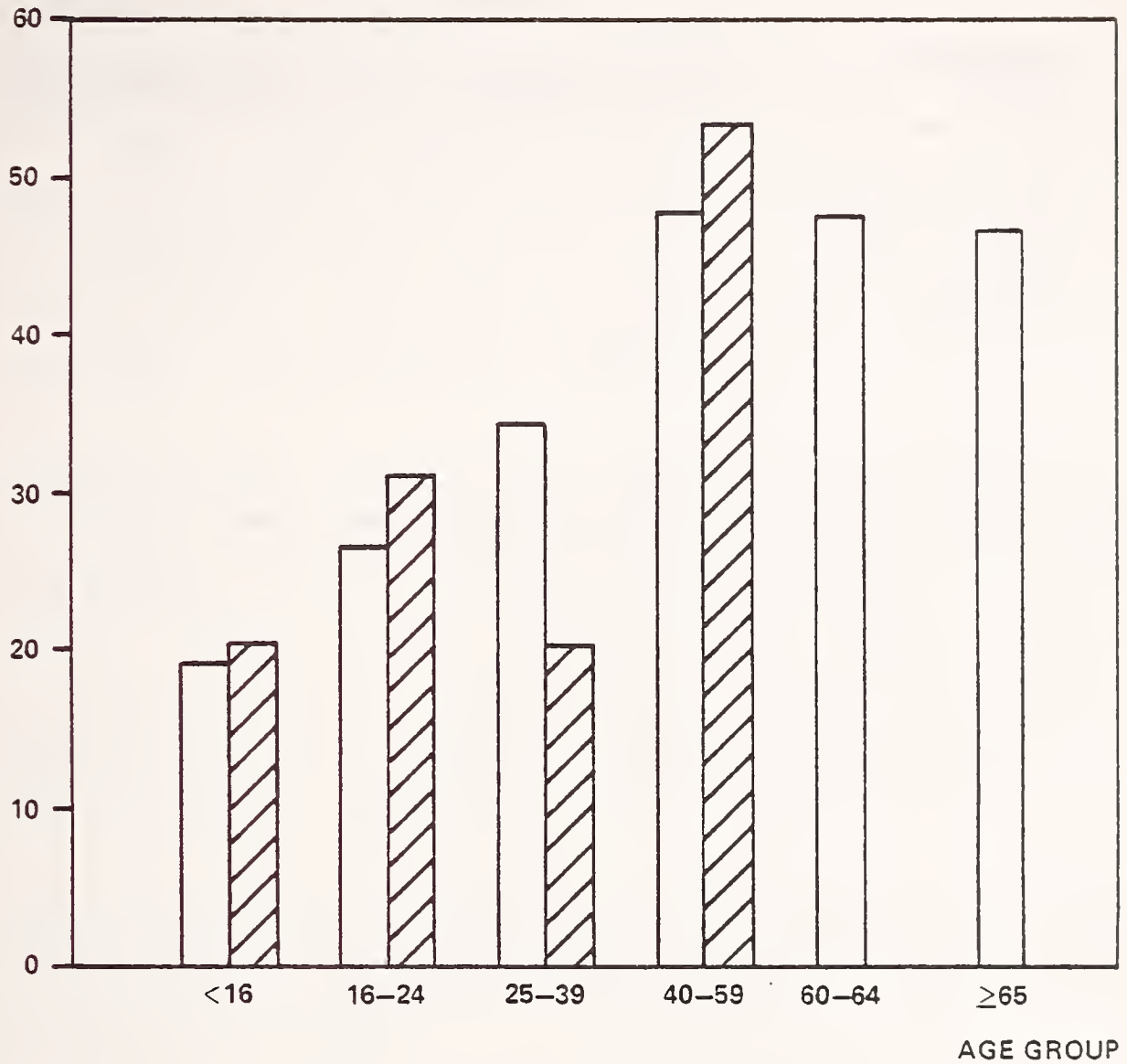
TransCard bus users who purchased a pass during the first month of pass sales were slightly more likely to be black males and black females and slightly less likely to be white males or white females (see Table 2-7). Conversely, individuals who are long-time rail TransCard users are more likely to be black females and white males and much less likely to be black males and white females.



Exactly one-third of both bus and rail cash users who had once purchased a TransCard, said that they had not bought a pass this month because they would not be riding often enough on MARTA. Eight percent of the rail cash users said the pass outlets were not conveniently located; 9 percent cited the high initial cost of the pass; 11 percent indicated that they changed jobs or residence and 13 percent gave variable work schedule as a reason. Conversely, almost half of the bus cash users gave a "no reason" or an "other" response to why they did not buy a pass this month. Apparently, a fairly high degree of apathy exists by some bus users with respect to their decision to buy a pass during any month.

The majority of TransCard individuals who had stopped buying a pass for at least one month could not recall a specific reason for their action. Of the responses given, the most frequent were "variable work hours" and "didn't ride MARTA enough." No particularly significant variation in responses was obtained when the results were disaggregated by different socioeconomic groups.

The reasons given by bus and rail cash individuals for why they have never purchased a TransCard were nearly the same as the reasons given by cash users during the before on board bus survey. Thus, the reader is referred to the discussion presented in Section 2.2.5.

PERCENT



 Bus TransCard
 Rail TransCard

SOURCE: After On-board Bus and Rail Surveys, May 1980.

FIGURE 2-30. TRANSCARD USERS WHO BOUGHT PASS DURING FIRST SALE MONTH BY AGE GROUP

TABLE 2-7. PERCENT OF TRANSCARD INDIVIDUALS
WHO BOUGHT PASS DURING FIRST SALE MONTH

<u>Category</u>	<u>Bus Users (%)</u>	<u>Rail Users (%)</u>
White Female	26.4	13.6
White Male	30.0	31.6
Black Female	37.6	37.0
Black Male	35.8	17.1

SOURCE: After On-Board Bus and Rail Surveys (May 1980).

2.3 FARE INCREASE EFFECTS

2.3.1 Effects on Gross Transit Revenue

After the 67 percent increase in transit fares that occurred on March 1, 1979, gross farebox revenues increased by about 60 percent. However, after netting out the effect of a simultaneous increase in gasoline prices, transit revenues increased by about 58 percent due to the systemwide fare increase. This result was obtained by first examining annualized revenues for a five month period before and a four month period after the fare increase. Four months was chosen because that is how long the bus system operated before the start on July 1, 1979 of rail service on the East Line. Thus, both the before and after revenue figures are not confounded by revenues and changes in travel behavior resulting from the rail service.

Table 2-8 presents monthly revenue for the stated time periods before and after the fare increase. To account for seasonality effects, monthly seasonality factors were developed based on historical monthly revenue data for the two-year period, March 1977 through February 1979. During this time fares were constant at \$.15. Using these factors to correct for seasonality, average monthly revenue was found to increase from \$790,513 to \$1,267,476 after the fare increase or by 60.3 percent. However, between the before and after period, gasoline prices increased by 16.1 percent from an average of \$0.69 to \$0.81 per gallon. Assuming a short-run transit cross-elasticity with respect to gasoline price of +0.1, average farebox revenues, net of the gasoline price increase, rose by 57.8 percent to \$1,247,070 (i.e., $\$1,267,476 \times [1 - (0.1 \times .161)]$).

The revenues attributable to individuals who paid with cash fares before and after the fare change increased by 61.7 percent, reflecting the 66.7 percent increase in fares and 2.5 percent decrease in the number of cash-paying transit users. However revenues from individuals who became TransCard users increased by only 36 percent.

From April to June 1979, an average of about 17,000 persons purchased TransCards each month. Prior to the fare increase these TransCard users made an average of 11.63 bus trips per week at 15¢ per trip (see Table 2-1). Assuming 4.2 weeks in a month, TransCard individuals were paying \$124,600 ($\pm \$2,100$ or ± 1.7 percent*) per month in cash fares before March 1, 1979.

*This measure of precision was estimated using the standard error of the estimate for TransCard user's (before) transit trip frequency evaluated at a 95 percent confidence interval (i.e., $1.96 \times$ trip frequency standard deviation $\div \sqrt{n} = 1.96 \times 4.67 \div \sqrt{2034} = \pm 0.20$ trips per week.)

TABLE 2-8. FAREBOX REVENUE BEFORE AND AFTER FARE INCREASE

<u>Month</u>	<u>Monthly Revenue</u>	<u>Monthly Seasonality Factor*</u>	<u>Monthly Revenue (seasonally adjusted)</u>
<u>Before</u>			
October 1978	\$887,735	1.1486	\$772,884
November	\$806,903	1.0439	\$772,970
December	\$737,738	0.9298	\$793,437
January, 1979	\$795,244	0.9608	\$827,732
February	<u>\$734,445</u>	0.9350	<u>\$785,545</u>
Average	\$792,413**		\$790,513
<u>After</u>			
March 1979	\$1,318,197	1.0398	\$1,267,802
April	\$1,286,036	0.9982	\$1,288,291
May	\$1,326,939	1.0485	\$1,265,559
June	<u>\$1,208,185</u>	0.9679	<u>\$1,248,254</u>
Average	\$1,284,839		\$1,267,476

*Based on revenue data for the two-year period, March 1977-February 1979.

**Twelve month average before fare increase equals \$792,786.

SOURCE: Metropolitan Atlanta Rapid Transit Authority.

After this time, when TransCards were being sold for \$10.00 per month, TransCard users were paying \$170,000 per month or an increase of 36 percent. Because some of the TransCard purchasers were also new transit riders they tend to inflate slightly the mean number of new trips taken. Thus, the average fare increase would be somewhat higher than 36 percent for prior transit users. Still, however, it is clear that pass buyers were not exposed to the full brunt of the fare increase.

2.3.2 Effect on Total Transit Trips and Individual Transit Users

Prior to the change in fares, post-fare-increase cash users made an average of 8.87 bus trips per week. Using an average monthly revenue of \$790,513 before the fare increase (from Table 2-8) and an average fare of 14.9¢, a total of 1,263,204 linked trips were taken on the bus system each week. Subtracting out the 197,710 trips taken by pre-TransCard buyers (i.e., 11.63 X 17,000) and dividing the remainder by the average of 8.87 bus trips taken per week by cash users, reveals that 120,124 individuals were using transit and paying with cash fares (and, of course who did not buy a TransCard after March 1, 1979).

Average monthly revenues after the fare increase rose to \$1,247,070. Dividing this by the new average fare of 23.5¢ and 4.2 weeks per month results in 1,263,494 linked trips made per week on the bus system. Subtracting out the 225,420 trips taken by TransCard users (i.e., 17,000 X 13.26) and dividing the remainder by 8.86 (the average number of bus trips made by cash users), yields 117,164 cash bus riders. Assuming that pre-fare increase cash users who discontinued using the bus and new cash paying users had average trip rates equal to those of regular cash users, then about 2,960 individuals (117,164 - 120,124) discontinued using the bus system in the months immediately after the fare increase. Because some of the pass users were new transit riders, and others increased the number of trips taken by transit, linked trips on the bus system actually increased by 290 trips per week after the fare increase. (Including the effects of the gasoline price increase, linked transit trips per week are calculated to have increased by about 21,000. As a check, MARTA records show that the total number of linked trips per week increased by about 40,000 in the months immediately following the fare increase.)

Table 2-9 summarizes the results of the analyses described above. It is interesting to note that whereas TransCard purchasers only represent about 12.7 percent of the individuals using the bus system, they account for 17.8 percent of the linked transit trips taken. (This latter percent is very close to the 16.9 of boarders who use TransCards which was determined by counting boarders on a random sample of 385 bus vehicle trips.)

TABLE 2-9. CHANGES IN REVENUE, NUMBER OF TRANSIT USERS,
AND LINKED TRIPS DUE TO THE FARE INCREASE

<u>Fare Type</u>	<u>Revenue per Month**</u>		<u>Percent of After Amount</u>	<u>Absolute Change</u>	<u>Percent</u>
	<u>Before</u>	<u>After</u>			
TransCard	\$124,600*	\$170,000	13.6	\$ 45,400	9.9
Cash	<u>\$665,913</u>	<u>\$1,077,070</u>	<u>86.4</u>	<u>\$411,156</u>	<u>90.1</u>
Total	\$790,513	\$1,247,070	100.0	\$456,556	100.0

<u>Individual Transit Users</u>					
TransCard	17,000***	17,000	12.7	0+	--
Cash	<u>120,124</u>	<u>117,164*</u>	<u>87.3</u>	<u>-2,960</u>	--
Total	137,124	134,164	100.0	-2,960	--

<u>Linked Trips per Week</u>					
TransCard	197,710	225,420	17.8	27,710	--
Cash	<u>1,065,494</u>	<u>1,038,074</u>	<u>82.2</u>	<u>-27,420</u>	--
Total	1,263,204	1,263,494	100.0	290	--

*Estimated precision within $\pm 2\%$ at 95% confidence limit.

**Adjusted for seasonality and effects of gasoline price increases.

***Cash payers who became TransCard buyers.

+Constrained to equal zero.

Payments from TransCard sales represent 13.6 percent of total monthly revenue. However, of the \$456,000 in new revenue generated by the fare increase, a disproportionately smaller 10 percent, was due to new revenue from TransCard users. Again, this highlights the fact that individuals who bought a TransCard were not exposed to the full impact of the fare increase.

2.4 MODAL AND INTERMODAL INTEGRATION

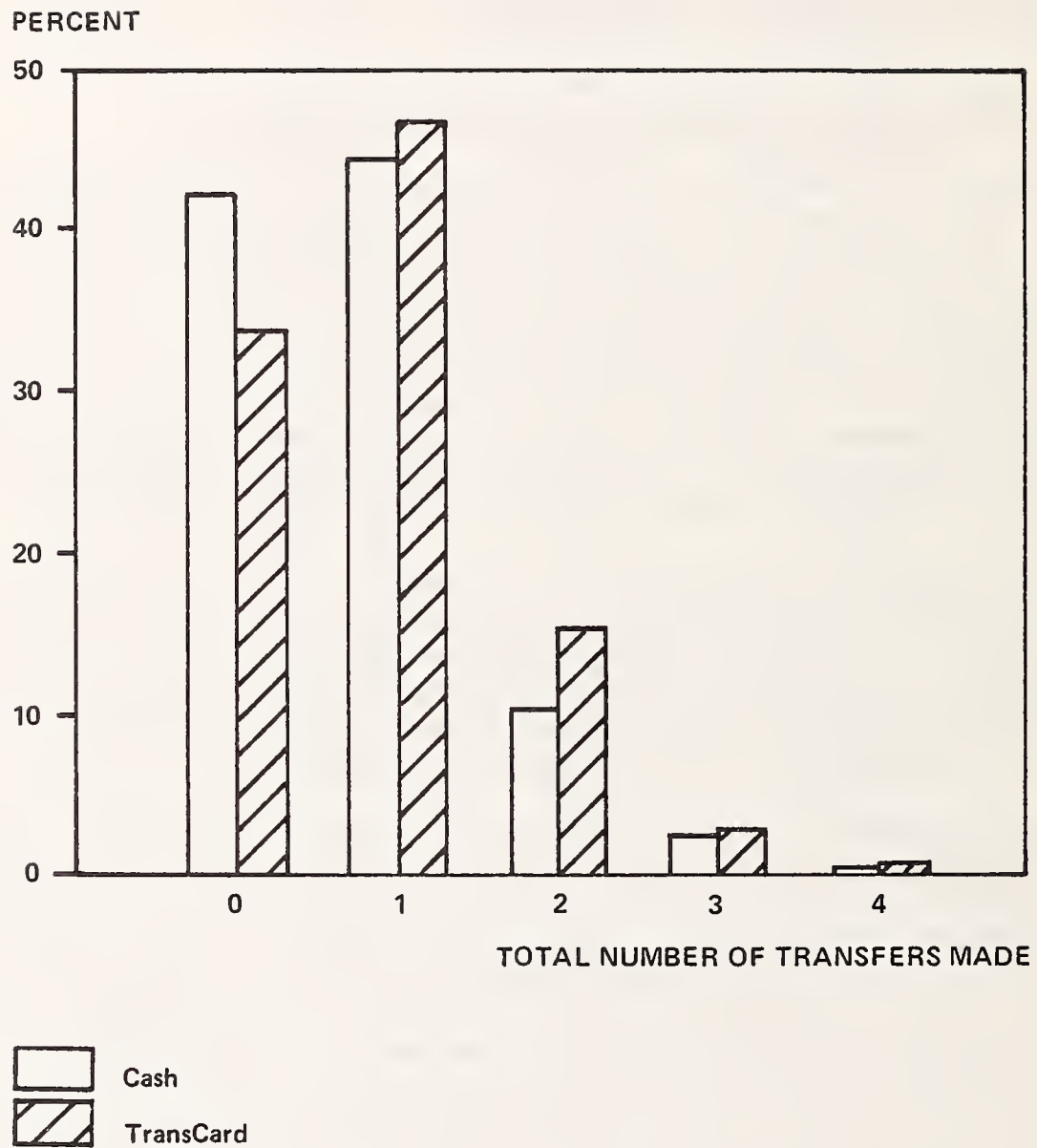
2.4.1 Influence of TransCard on Intramodal Integration

This section of the report analyzes the extent to which intramodal integration between bus routes is promoted by an unlimited-use transit pass. One way this issue can be addressed is by examining whether transit passes are purchased in disproportionately larger numbers by individuals who must transfer one or more times in making a particular trip. For example, Figure 2-31 illustrates that individuals who make one or more bus-to-bus transfers are more likely to have a TransCard than individuals who do not transfer. However, Figure 2-31 also indicates that the relationship is not entirely linear. That is, individuals who transfer three times, are not more likely to use a pass compared to individuals transferring only twice.

With this type of analysis approach, however, it is not possible to control for other factors that may also influence transfer and pass buying behavior. For example, if frequent users of the bus system are more likely to buy a TransCard, and if frequent users also transfer more often (i.e., because they are transit dependent) then there will be a hidden correlation which could influence conclusions drawn by examining Figure 2-31.

One way to control for these "other" factors is to estimate a model that specifies these exogenous factors as independent variables. However, because the dependency between transfer rate and TransCard use is not clear, the possibility of simultaneous equation bias exists. Thus a linear model estimated with ordinary least squares may not be appropriate. The procedure selected therefore was to estimate two models using two stage least-squares regression. In the first equation, the number of transfers was specified as the dependent variable; while the second equation used a 0,1 term to indicate whether the individual was a pass or cash user.* Table 2-10 presents the parameter estimates and associated statistics for these two models. All of the estimated coefficients have the expected sign although some were not significantly different from zero.

*When using binary data, it is usually preferable to use a weighted nonlinear function. However, a linear model can be used in this instance because of the very large sample size and the nearly equal split between cash and TransCard individuals included in the sample.



SOURCE: Before On-board Bus Survey, May 1979.

FIGURE 2-31. NUMBER OF TRANSFERS MADE BY CASH AND TRANSCARD INDIVIDUALS

TABLE 2-10. SIMULTANEOUS EQUATION MODELS OF NUMBER OF TRANSFERS MADE AND USE OF A TRANSCARD

MODEL: TWO		SSE	1927.646	F RATIO	69.03		
		DFE	3729	APPROX PROB:	0.0001		
		MSE	0.516934	R-SQUARE	0.1692		
DEF VAR: TOTAL # OF TRANSFERS							
SECOND STAGE STATISTICS							
VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	APPROX PROB:	VARIABLE LABEL	
INTERCEPT	1	0.504630	0.061076	8.2624	0.0001		
ONE.PASSIUM	1	0.126080	0.149931	0.8409	0.4004	USED TRANSCARD	
WORKTRIP	1	0.005218349	0.005802589	0.8871	0.3751	# OF WORK TRIPS	
OTHRTRIP	1	0.002407931	0.003535	0.6812	0.4958	# OTHER TRIPS/WK	
AGEM	1	-0.0019919	0.001086528	-1.8333	0.0668	AGE MIDPOINT	
INCOMEM	1	-.0000063975	.00000171796	-3.7239	0.0002	INCOME MIDPOINT	
SEXUUM	1	0.006873553	0.025241	0.2723	0.7854	FEMALE	
RACEDUM	1	0.317735	0.028784	11.0385	0.0001	NONWHITE	
AUTOIDUM	1	-0.018805	0.027322	-0.6883	0.4913	AUTO AVAILABLE	
MNTHRIDG	1	0.000226907	0.0001106832	2.0501	0.0404	# MONTHS RIDING MARTA	
CORRIDUM	1	-0.071511	0.023990	-2.9808	0.0029	NORTH OR WEST CORRIDOR	
ERRIDUM	1	0.642773	0.033062	19.4414	0.0001	STOPPED FOR ERRANDS	

MODEL: THREE		SSE	840.377434	F RATIO	46.10		
		DFE	3729	APPROX PROB:	0.0001		
		MSE	0.225363	R-SQUARE	0.1197		
DEF VAR: USED TRANSCARD (1 = yes; 0 = no)							
SECOND STAGE STATISTICS							
VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	APPROX PROB:	VARIABLE LABEL	
INTERCEPT	1	-0.378891	0.057639	-6.5735	0.0001		
ONE.TTRANSFRS	1	0.123829	0.031465	3.9354	0.0001	TOTAL # OF TRANSFERS	
WORKTRIP	1	0.029860	0.002085072	14.3206	0.0001	# OF WORK TRIPS	
OTHRTRIP	1	0.015965	0.001599798	9.9795	0.0001	# OTHER TRIPS/WK	
AGEM	1	0.002392293	0.0006918084	3.4580	0.0006	AGE MIDPOINT	
INCOMEM	1	-5.78077E-07	.00000115008	-0.5026	0.6152	INCOME MIDPOINT	
SEXUUM	1	0.041826	0.016003	2.6137	0.0090	FEMALE	
RACEDUM	1	-0.072771	0.021710	-3.3519	0.0008	NONWHITE	
AUTOIDUM	1	-0.043743	0.017481	-2.5023	0.0124	AUTO AVAILABLE	
MNTHRIDG	1	-.0000432078	.00007348559	-0.5880	0.5566	# MONTHS RIDING MARTA	
CORRIDUM	1	0.007350298	0.015936	0.4612	0.6447	NORTH OR WEST CORRIDOR	
KNOWIDUM	1	0.417269	0.041947	9.9475	0.0001	KNOWLEDGE OF TRANSCARD	

SOURCE: Charles River Associates, based on data from before on-board bus survey (May 1979)

Many useful inferences can be drawn from the estimated models. First, the insignificant TransCard term (PASSDUM) in the transfer model indicates that individuals who buy a pass are not more likely to go out and make more transfers. This comports with the notion that travel is a derived demand, not consumed for its own purposes but rather to undertake an activity at the end of the trip.

Conversely, the positive and significant transfer coefficient in the TransCard model, indicates that all else considered, individuals who make one or more transfers are more likely to have purchased a TransCard. This finding supports the hypothesis that transit passes are relatively more likely to be used as an instrument for intramodal fare integration than cash fares. ("Relatively" is used here since many transit users, including those who transfer, continue to pay with cash fares).

Based on the results of the transfer model presented in Table 2-10, individuals who transfer are more likely to have the following characteristics:

- lower average age
- lower incomes
- more minorities
- riding MARTA longer
- stopped for errand on trip

Interestingly, factors such as the number of work and nonwork trips made per week and whether an auto was available for the trip being taken, were not important variables in explaining the number of bus-to-bus transfers that were made.

Similarly, from the TransCard model, the following characteristics describe individuals who are more likely to buy a pass:

- more transfers required
- more work trips taken
- more nonwork trips taken
- older age
- more females
- more minorities
- less likely to have an auto available

Income, months riding MARTA, and corridor were not important descriptors of TransCard purchaser. According to the magnitude of the parameter estimates, the number of work trips made are about twice as important in determining whether an individual bought a pass compared to the number of nonwork trips taken. Being required to make a transfer is weighted equivalently to four one-way work trips. Other similar analyses are left to the discretion of the reader.

2.4.2 Influence of TransCard on Intermodal Integration

The bus/rail integration issue is similar in concept to the bus-to-bus integration issue analyzed above. However, whereas the bus system operates with a system of free transfers ubiquitously over the MARTA service area, only half the rail system was operating with a coordinated set of feeder buses at the time of the after surveys. In particular, only the East Line, was being served by a coordinated feeder bus network. On the West Rail line, coordinated feeder buses were operating on only half the routes serving only one of the rail stations (Hightower). The remaining stations had no coordinated bus feeder service.

This difference in the feeder bus network can be used to evaluate the issue of bus to rail integration. In particular relating transfer rates between modes serving the east and west corridors should be indicative of how well transfers can be accomplished between the bus and rail system given the differences in service mentioned above.

Table 2-11 presents the percentages of cash and TransCard individuals who made either no transfers or one or more transfers (to either another bus or the rail system) to complete the particular trip that they were making at the time of the bus survey. Because of the feeder bus service integration, both cash and TransCard users were much more likely to have transferred from the bus to the rail mode in the East Corridor compared to the West Corridor. Illustrating the integration advantages of the pass, individuals with TransCards were more likely to transfer to either the bus or rail modes than cash users, especially in the East Corridor. (This result is consistent with the findings of the regression models presented in Section 2.4.1 for bus to bus transfers.)

The last column in Table 2-11 presents the relative difference in transfers made by TransCard and cash users between the East and West corridors. The numbers indicate a slight, but relatively more positive integration between the bus and rail modes than between the bus modes. A similar finding could also have been obtained by computing the relative percentage difference (between cash and TransCard users) in transfers required to the bus (11.9 percent) and rail (16.8 percent) modes for the East Corridor in Table 2-11.

In summary, bus/rail (feeder) service integration has the largest impact on intermodal integration followed by a much smaller, but positive effect due to TransCard. TransCard's effect on bus-to-rail integration appears to be slightly larger than its effect on bus-to-bus integration.

TABLE 2-11. COMPARISON OF TRANSFERS REQUIRED BY CORRIDOR FOR CASH AND TRANSCARD INDIVIDUALS

<u>Transfer*</u> <u>Required</u>	<u>East Corridor (%)</u>			<u>West Corridor (%)</u>			<u>Difference</u> <u>(E-W)</u>
	<u>Cash</u>	<u>Trans-</u> <u>Card</u>	<u>Difference</u>	<u>Cash</u>	<u>Transcard</u>	<u>Difference</u>	
No	64.9	58.8	--	62.9	58.6	--	--
To Bus	19.3	21.6	+2.3	30.0	31.7	+1.7	+0.6%
To Rail	10.7	12.5	+1.8	5.2	5.4	+0.2	+1.6%
To Bus+Rail	<u>5.1</u>	<u>7.1</u>	+2.0	<u>1.9</u>	<u>4.3</u>	+2.4	<u>-0.4%</u>
	100.0%	100.0%		100.0%	100.0%		

*Response to question 5a on after bus survey.

SOURCE: After On-Board Bus Survey (May 1980).

2.5 BARRIER-FREE STATION DESIGN

2.5.1. Fare Evasion and Revenue Loss at Barrier-Free Station

Access ramps at barrier-free stations effectively prohibit any fare evasion and thus revenue loss.

2.5.2 Rail Bus Integration at Barrier-Free Station

One aspect of the bus/rail integration issue was whether a "barrier-free" rail transit station would enhance rail-bus integration compared to stations with "barriers" (i.e., going through a turnstyle using a TransCard or a transfer "card" obtained from a bus driver). To evaluate this concern individuals responding to the "after" bus and rail surveys who transfer between bus and rail were asked to rate the convenience of transferring on a scale of one to five with one being very good and five being very poor. Mean convenience rates were computed for cash and TransCard users according to the rail station where the transfer occurred.

The mean convenience rates for cash and TransCard bus users who transferred to rail at the barrier-free Avondale station were 1.81 and 1.76 respectively.* The hypothesis that these means are the same cannot be rejected ($t=0.19$). Thus, as we would have hoped, individuals who initially boarded a bus and paid a cash fare (but who were not required to obtain a transfer card from the bus driver to transfer at Avondale) have the same convenience rating as TransCard users who also do not need to present anything when transferring at the Avondale station.

Mean convenience ratings were also not significantly different between cash and TransCard individuals (1.93 and 1.88 respectively) who transferred from rail to bus at the barrier-free Avondale station. The same results were obtained for cash and TransCard individuals in the rail survey who transferred to a bus line (means of 1.97 and 2.02 respectively.)

Unfortunately, there was also no significant difference between convenience ratings at Avondale station and all other stations on the East rail line. The results were the same for cash and TransCard users and for individuals surveyed on board the bus or rail modes. Consequently, this particular analysis approach could not detect a measurable bus-to-rail enhancement due to the barrier-free station at Avondale.

*While only about half the bus routes feeding Avondale station make use of the barrier-free concept, 76.7 percent of the on-board bus respondents were on routes that used the barrier-free portion of the station.

As an aside, there was a significant difference between the mean convenience ratings given by cash users transferring on the East line compared to those users transferring on the West rail line (means of 1.72 and 2.34 respectively). Such a finding is a reflection of the coordinated bus feeder system on the East line compared to the basically uncoordinated bus-rail operation (except for some buses feeding the Hightower station) on the West rail line. Oddly, however, there was not a similar significant difference between TransCard users who transferred on the East line versus the West line (means of 1.72 and 1.75 respectively).

2.6 EFFECTS OF RAIL SYSTEM

2.6.1 Rail Transit Diversion Versus Generation of Trips

Individuals contacted during the after on-board rail survey were asked whether they were regular MARTA riders before the rail service started. As a control, the identically-worded question was also included on the after bus questionnaire. As shown in Table 2-12, the results indicate that the rail system generated more new transit riders compared to the normal turnover in the population of bus transit users, including those new riders who use bus as a feeder mode to the rail station. However, because few bus-to-rail transfer individuals were included in the rail survey, the proportion of new rail transit users given in Table 2-12 likely overstates the true percentages.

The relatively lower percentage of new rail riders who are TransCard users compared to new rail cash-paying users reflects the fact that TransCard individuals tend to be more frequent transit users. Thus they are more likely to be transit dependent and therefore previous users of MARTA before the rail line opened. As Figure 2-32 illustrates the majority of cash-paying rail riders are relatively infrequent MARTA users, taking between one and five one-way transit trips per week. Conversely, the majority of TransCard users make at least ten one-way trips per week. (The decaying-exponential shape of the cash rail user bar graphs and the (approximately) normally distributed shape of the TransCard rail user bar graphs are very similar to those presented in Figure 2-7 for bus cash and TransCard individuals.)

While both the rail pre-test survey and the after on-board rail survey indicate that about 60-70 percent of the rail riders previously used MARTA (i.e., bus), data from the rail pre-test survey show that the majority of new transit users previously used an automobile to make the trip now being taken by rail. As shown in Table 2-13 about 62 percent of the rail trips were

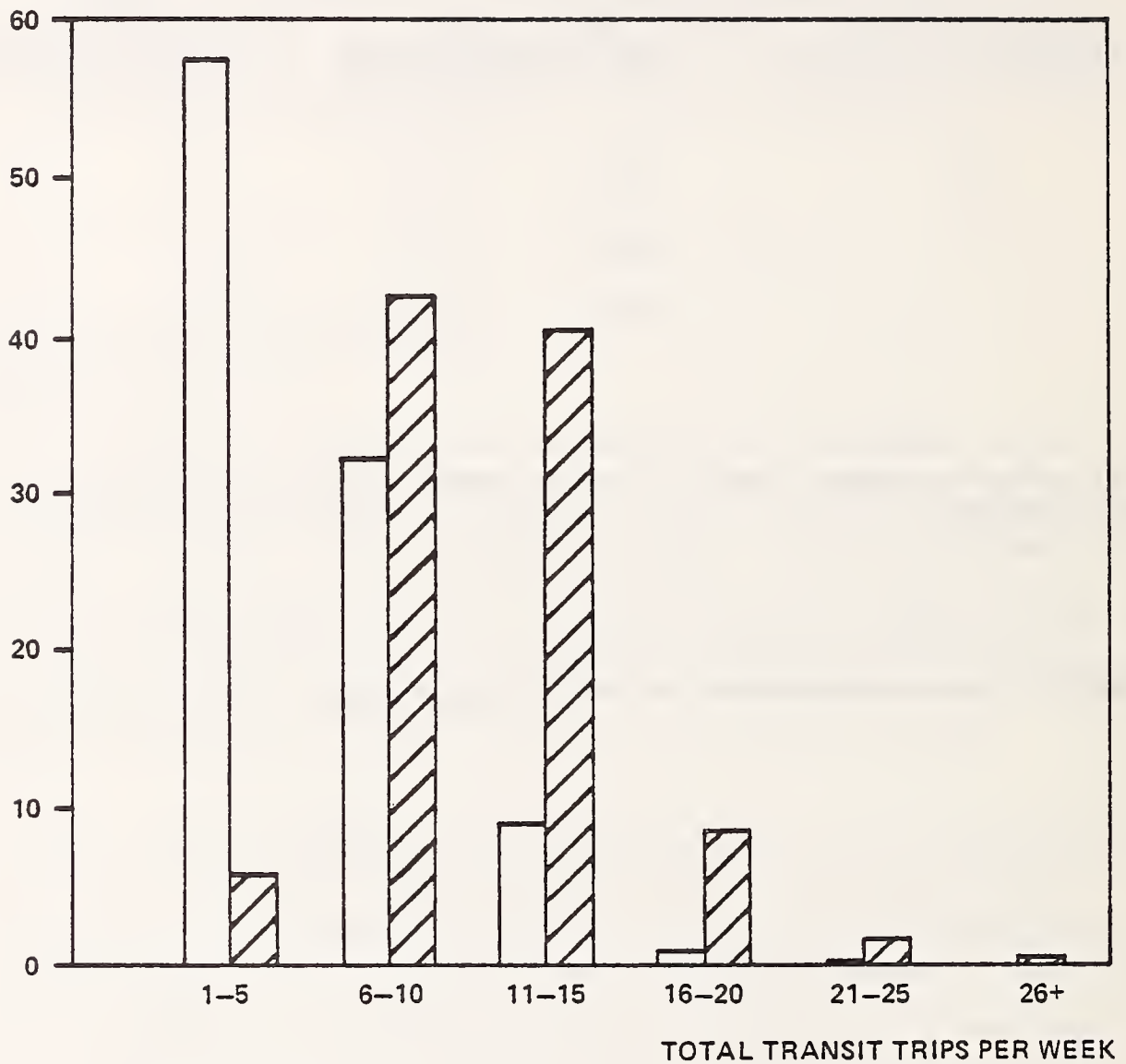
TABLE 2-12. PERCENT OF RAIL AND BUS USERS
WHO WERE REGULAR MARTA RIDERS BEFORE RAIL SYSTEM

<u>Regular Rider Before Rail Started</u>	<u>Rail Users* (%)</u>		<u>Bus Users (%)</u>	
	<u>Cash</u>	<u>TransCard</u>	<u>Cash</u>	<u>TransCard</u>
Yes	59.2	74.5	82.7	88.0
No	<u>40.8</u>	<u>25.5</u>	<u>17.3</u>	<u>12.0</u>
	100.0	100.0	100.0	100.0

*Note: survey sample does not include certain individuals who transfer from bus to rail.

SOURCE: After On-Board Bus and Rail Surveys (May, 1980).

PERCENT



 Cash
 TransCard

SOURCE: After On-board Rail Survey, May 1980.

FIGURE 2-32. TOTAL TRANSIT TRIP FREQUENCY CHARACTERISTICS OF CASH AND TRANSCARD RAIL TRANSIT INDIVIDUALS

TABLE 2-13. RAIL ACCESS MODE BY MODE USED
BEFORE RAIL LINE OPENED
(Percent)

<u>Prior Mode</u>	Rail Access Mode				<u>Total</u>
	<u>Auto Driver</u>	<u>Auto Passenger</u>	<u>MARTA Bus</u>	<u>Walk and Other</u>	
Auto Driver	16.8	0.9	7.1	3.2	28.0
Auto Passenger	0.3	--	--	--	0.3
MARTA Bus	10.3	2.0	38.5	10.8	61.6
Walk and Other	0.8	--	0.8	0.6	2.2
No Prior Trip	<u>3.9</u>	<u>0.6</u>	<u>1.7</u>	<u>1.7</u>	<u>7.9</u>
Total	32.1%	3.5%	48.1%	16.3%	100.0%

SOURCE: Metropolitan Atlanta Rapid Transit Authority, "November 1979 Survey of MARTA Westbound Rail Passengers (Weekdays only)," February 1980.

previously taken by bus, 30 percent were diverted from other modes, and about 8 percent represented newly generated trips. (MARTA, which tabulated the results shown in Table 2-13 weighted the sample by boarding counts at each rail station but not by transit trip frequency.) Consequently, of only the "new" rail trips, about 75 percent were previously taken by auto, the vast majority being as an auto driver.

Of the rail trips that were previously made by bus, bus is still used 68 percent of the time as an access mode to the rail station. However, the remaining 32 percent of trips formerly taken by bus are now being made by a nontransit mode to reach the rail stations. In particular, about 45 percent of these rail access trips are now made by auto drivers, 9 percent by auto passengers and 46 percent by walk and other modes. With the data currently tabulated, it is not possible to determine the number of former bus users that switched to a nontransit mode when bus routes were reconfigured to feed the rail transit line. From aggregate data it is clear that total transit trips increased first because of the new rail service and second, because more bus miles could be devoted to collector/distributor functions rather than line-haul service.

2.6.2 Intermodal Integration: Bus/Rail Service Improvements Vs. TransCard

See discussion presented in Section 2.4.2 which concluded that bus/rail service coordination resulted in a much higher level of intermodal integration than did the pass. Although small, TransCard's intermodal integration effects were still positive, however.

APPENDIX A. SURVEY QUESTIONNAIRES

- Before On-board Bus (May 1979)
- Westbound Rail (Pre-test) Survey (November 1979)
- After On-board Bus (May 1980)
- After On-board Rail (May 1980)

MARTA TransCard/Integrated Fare Collection Evaluation Project - Bus On-Board Survey Questionnaire Survey I

Form Number _____
 Route Number _____
 Inbound (1)/Outbound (2) _____
 Time: _____ : _____ AM/PM

Interviewer _____
 Edited by: _____

Hello, I work for MARTA and we're doing a survey to obtain information to help serve our riders better. May I ask you a few questions. None of the information you give me can be traced back to you as an individual.

_____ Refused _____ TransCard _____ Cash _____ Transfer

Questions for TransCard Riders Only

- How did you pay when you boarded this bus?
 1) cash fare
 2) TransCard
- Before beginning this trip, where did you come from?
 1) home
 2) work
 3) school
 4) shop
 5) personal business
 6) social-recreational
 7) church
 8) other _____
- How many transfers have you made? _____
- Did you stop off at any place you transferred or any other place to run an errand or shop etc.?
 1) yes
 2) no
- What kind of place are you going to:
 1) work
 2) home
 3) school
 4) shop
 5) personal business
 6) social-recreational
 7) church
 8) other _____
- Will you have to transfer to another bus to get there:
 1) yes
 2) no
- How many times? _____
- Do you plan to stop off at any place where you will transfer or any other place to run errands or shop etc.?
 1) yes
 2) no
- If you did not ride the bus, how would you make this trip?
 1) drive car
 2) passenger in car
 3) walk
 4) wouldn't make trip
 5) other _____
- Generally, do you have an automobile available for your use?
 1) yes
 2) no
- How long have you been riding MARTA?
 _____ month/_____ years
- How many times per week do you use the bus to go to work? _____
- How many times per week do you use the bus to go home from work? _____
- In addition, how many one-way bus trips do you make per week for other than to get to and from work? _____
- Having the TransCard, do you use MARTA more or the same as before...
 - to go to work?
 1) same
 2) more
 (If "more") _____ number/week
 - to go to other places besides work?
 1) same
 2) more
 (If "more") _____ number/week
- How long have you used TransCard _____ (months)
- Where did you first learn about TransCard?
 1) Rider's Digest
 2) bus poster
 3) radio
 4) Journal/Constitution
 5) other newspaper
 6) television
 7) friend
 8) other _____
- Why did you buy TransCard?
 1) first reason
 2) second reason
 1) allows stopovers
 2) save money
 3) pay only once each month
 4) easier/faster to get on the bus
 5) more convenient/do not need cash
 6) offset the fare increases
 7) makes transferring easier
 8) other _____
- Do you plan to continue to buy it?
 1) yes
 2) no
- Where did you buy your TransCard?
 1) RideStore
 2) other (ask where) _____
- Would you be interested in buying a TransCard that would be good for
 - a week? _____
 - a year? _____
 No opinion _____ (go to #21)

Questions for Cash/Transfer Passengers Only

- How did you pay when you boarded this bus?
 1) cash fare
 2) transfer
- What was the amount of the fare _____
 1) regular
 2) student
 3) elderly/handicapped
- Before beginning this trip, where did you come from?
 1) home
 2) work
 3) school
 4) shop
 5) personal business
 6) social-recreational
 7) church
 8) other _____
- How many transfers have you made? _____
- Did you stop off at any place you transferred to run an errand or shop etc.?
 1) yes
 2) no
- What kind of place are you going to:
 1) work
 2) home
 3) school
 4) shop
 5) personal business
 6) social-recreational
 7) church
 8) other _____
- Will you have to transfer to another bus to get there:
 1) yes
 2) no
- How many times? _____
- Do you plan to stop off at any place where you will transfer to run errands or shop etc.?
 1) yes
 2) no
- If you did not ride the bus, how would you make this trip?
 1) drive car
 2) passenger in car
 3) walk
 4) wouldn't make trip
 5) other _____
- Generally, do you have an automobile available for your use?
 1) yes
 2) no
- How long have you been riding MARTA?
 _____ month/_____ years
- How many times per week do you use the bus to go to work? _____
- How many times per week do you use the bus to go home from work? _____
- In addition, how many one-way bus trips do you make per week for other than to get to and from work? _____
- Since the MARTA fare was increased, do you currently use MARTA more, less, or the same as before...
 to go to work?
 1) the same
 2) less
 3) more
 4) N/A
 (If "less" or "more") _____ number/week
 to go to other places besides work?
 1) the same
 2) less
 3) more
 4) N/A
 (If "less" or "more") _____ number/week
- Do you know about the MARTA monthly pass called TransCard?
 1) yes
 2) no (go to #21)
- If yes: Where did you first learn about TransCard?
 1) Rider's Digest
 2) Bus Poster
 3) Radio
 4) Journal/Constitution
 5) Other Newspaper
 6) Television
 7) Friend
 8) Other _____
- Have you bought a TransCard in an earlier month?
 1) yes
 2) no (if no go to #19)
 If yes:
 a. For what reasons did you buy it? _____
 b. Will you buy it again? 1) Yes 2) No
 c. If no: Why not? _____
 d. Where did you buy your TransCard?
 1) Ridestore 2) other _____
 (Stop to #20)
- For what reasons have you not bought TransCard?
 1) afraid I'll lose it
 2) did not know WHERE to buy it
 3) outlets not conveniently located
 4) initial cost too high
 5) do not ride MARTA enough
 6) no opinion
 7) Other _____
- Would you be interested in a TransCard that would be good for
 - a week? _____ or - a year? _____ no opinion _____

Questions for All Respondents

- What are the first three digits of your telephone number (exchange prefix)? _____
- Looking at the card, what letter matches your age bracket?
 A) under 18
 B) 18-24
 C) 25-39
 D) 40-59
 E) 60-64
 F) 65 and over
 G) refused to answer
- Also on the card, what letter matches the combined annual income for your entire household?
 A) less than \$5,000
 B) \$5,000 - \$9,999
 C) \$10,000 - \$14,999
 D) \$15,000 - \$24,999
 E) \$25,000 and over
 F) don't know
 G) refused
- Including yourself how many persons are there in your household? _____
- 2.5. WF WM BF SM OF
 OM Visibly Handicap

No 00045

marta WESTBOUND RAIL PASSENGER SURVEY - NOVEMBER 1979

We need your help to improve service. PLEASE COMPLETE A SURVEY EACH TIME YOU RIDE THE TRAIN TODAY. Your answers will be kept strictly confidential. Place completed surveys in specially marked bags in train stations or in the mail - postage free. THANK YOU FOR HELPING MARTA

- 1 How did you PAY for this trip?
(A) TransCard
(B) 25c (regular fare)
(C) 15c (City of Atlanta student fare)
(D) 10c (elderly or handicapped fare)
(E) Other special fare.

2 Does this trip BEGIN or END at your home?
(A) Yes - BEGINS at home
(B) Yes - ENDS at home
(C) No - Does NOT begin OR end at home

3 What is the PURPOSE of this trip?
(A) Going to or from work
(B) Going to or from school
(C) Going to or from shopping
(D) Going to or from personal business or medical
(E) Going to or from social visit, recreation or entertainment

4 What is the ADDRESS of the place where this trip BEGAN?
Street number and name preferred or closest intersection, landmark or building name City GA Zip Code if known

- 5 How far is that place from the nearest MARTA BUS STOP?
(A) Less than one block
(B) 1 - 2 blocks
(C) 3-4 blocks
(D) 5 blocks - 1 mile
(E) 1 mile - 2 miles
(F) More than 2 miles
(G) Don't know

- 6 At which MARTA station did you get ON this train?
(A) Avondale
(B) Decatur
(C) East Lake
(D) Edgewood - Candler Park
(E) Inman Park - Reynoldstown
(F) King Memorial

- 7 How did you COME to the MARTA station where you got on this train?
(A) Walked all the way. How far? blocks
(B) Rode MARTA bus. Which route? number and name
(C) Drove. HOW MANY PEOPLE IN THE CAR?
(D) Rode with someone who dropped me off
(E) Rode with someone who parked at or near the station
(F) Bicycle
(G) Other please write your answer

- 8 At which MARTA station will you get OFF this train?
(A) Georgia State
(B) King Memorial
(C) Inman Park - Reynoldstown
(D) Edgewood - Candler Park
(E) East Lake
(F) Decatur

- 9 When you get OFF this train, how will you COMPLETE this trip?
(A) Walk all the way. How far? blocks
(B) Ride MARTA bus. Which route? number or name
(C) Drive
(D) Ride with someone who will pick me up
(E) Ride with someone who parked near the station
(F) Other please write your answer

10 What is the ADDRESS of the place where you are GOING to on this trip?
Street number and name preferred or closest intersection, landmark or building name City GA Zip Code if known

- 11 Will you (or did you) use the TRAIN today when making this trip in the OTHER DIRECTION?
(A) Yes
(B) No. IF NO: How will you (or did you) travel?
(C) Ride a MARTA Bus
(D) Other please write your answer
(E) No trip in other direction

- 12 How many times a WEEK do you usually make this trip on the TRAIN?
(A) Less than once a week
(B) 1 - 2 times a week
(C) 3 - 4 times a week
(D) 5 times a week
(E) 6 or more times a week

- 13 BEFORE THE MARTA TRAIN SERVICE BEGAN, how did you make this trip?
(A) Drove
(B) Got a ride with someone
(C) Rode MARTA bus. Route number or name
(D) Walked
(E) Did not make this trip
(F) Other please write your answer

- 14 Was a car or truck AVAILABLE to you today to make THIS TRIP?
(A) Yes
(B) No

- 15 HOW MANY CARS or TRUCKS are kept at your home for use by members of your household?
(A) 1
(B) 2
(C) 3 or more

16 Including yourself, how many people live in your home?
Number of persons

- 17 Are you
(A) Under 16
(B) 16 - 24
(C) 25 - 34
(D) 35 - 44
(E) 45 - 54
(F) 55 - 64
(G) 65 or over

- 18 Are you
(A) Black
(B) White
(C) Hispanic
(D) Other please write your answer

- 19 How much is the COMBINED YEARLY income for EVERYONE living in your home including yourself?
(A) Less than \$5,000
(B) 5,000 - 9,999
(C) 10,000 - 14,999
(D) 15,000 - 24,999
(E) 25,000 - 34,999
(F) 35,000 or over
(G) Other please write your answer

MARTA TransCard/Integrated Fare Collection Evaluation Project-Bus On-Board Survey Questionnaire Survey 2

Form Number _____
 Route Number _____
 Inbound (1)/Outbound (2) _____
 Time: _____ AM/PM

Interviewer _____
 Edited by _____

Hello, I work for MARTA and we're doing a survey to obtain information to help serve our riders better. May I ask you a few questions. None of the information you give me can be traced back to you as an individual.

Refused _____ TransCard _____ Cash _____ Transfer _____

Questions for All Respondents

1a. How did you pay your fare when you boarded this bus?
 1. Cash 2. Transfer 3. TransCard 4. Other

1b. (CASH FARE ONLY) What was the amount of the fare?
 1. Regular 2. Student 3. Elderly/Handicapped 4. Other

2. Before beginning this trip, where did you come from?
 1. home 2. work 3. school 4. shop
 5. personal business 6. social-recreational 7. church 8. other

3a. How many times have you transferred on this trip? _____

3b. Did you transfer from the rail line? 1. yes 2. no

3c. (IF YES TO 3b) At what station? _____

4. What kind of place are you going to?
 1. home 2. work 3. school 4. shop
 5. personal business 6. social-recreational 7. church 8. other

5a. Will you have to transfer to get there?
 1. no 2. yes-to bus 3. yes-to rail 4. yes-to both bus and rail

(CONTINUE FOR PEOPLE WHO TRANSFER ONLY)

5b. How many transfers will you make? _____

5c. (IF TRANSFERRING TO RAIL) At what station? _____

(PEOPLE WHO TRANSFER TO/FROM RAIL ONLY)
 On a scale of one to five, with one being very good and five being very poor, how do you rate the convenience of transferring between bus and rail?

5e. Downtown? _____

5f. In the suburbs? _____

6c. What are your specific problems in or comments on transferring between bus and rail?

7. If you did not ride the bus, how would you make this trip?
 1. carpool all the way 2. carpool to MARTA station 3. kiss-ride to MARTA station 4. drive car all the way 5. drive car to MARTA station 6. ride with someone all the way
 7. ride with someone to MARTA station 8. walk 9. bicycle 10. taxi 11. would not make trip 12. other

8. How did you get to the bus initially to begin this trip?
 1. walk 2. drive by myself 3. drive with passenger(s) 4. Bicycle
 5. ride with someone 6. other

9a. How many times did you use MARTA to GET TO WORK last week? _____

9b. How many times did you use MARTA to GO HOME FROM WORK last week? _____

9c. In addition, how many other ONE-WAY trips did you make on MARTA last week? _____

9d. Was your travel by MARTA last week typical of your normal use?
 1. yes 2. no
 IF YES, what is typical? _____ more or _____ less

10. How long have you been riding MARTA?
 _____ years/_____ months

11. Were you a regular MARTA rider before rail service was begun?
 1. yes 2. no

Questions for TransCard Respondents Only

12a. How long ago (when) did you buy your first TransCard?
 _____ months ago or _____ 19____

12b. How often have you bought TransCard since then? _____ months
 1. every month (100%)
 2. nearly every month (80-99%)
 3. most months (60-79%)
 4. some of the time (40-59%)
 5. rarely (less than 40%)
 6. this is the first month
 7. other _____

12c. (IF NOT 1 or 6 IN 12b) Why have you not bought TransCard every month?
 1. afraid I would lose it
 2. did not know where to buy it
 3. no convenient outlet
 4. initial cost too high
 5. did not ride often enough (include vacation)
 6. changed job or residence (unemployed during period)
 7. variable work schedule
 8. no reason
 9. other _____

13. Were you a regular MARTA rider before buying TransCard?
 1. yes 2. no

14. Why do you buy TransCard? (1 first reason-2 second reason)
 1. avoids stoovers 2. saves money 3. pay only once each month 4. easier/faster to get on bus or train
 5. more convenient/no change needed 6. makes transferring easier

15. (ASK FOR WORK TRIPS ONLY)
 15a. Would you prefer to buy TransCard through your employer?
 1. yes 2. no 3. already do

15b. Employer's name _____

Questions for Cash/Transfer Respondents Only

12a. Have you ever bought TransCard?
 1. yes 2. no 3. What is TransCard
 (IF YES) first time: _____ 19____ (month)

12b. (IF 1 IN 12a) How many times have you bought TransCard?
 _____ months
 1. null
 2. nearly every month (80-99%)
 3. most months (60-79%)
 4. some of the time (40-59%)
 5. rarely (less than 40%)
 6. null
 7. other _____

12c. (CONTINUE FROM 12b) Why did you not buy TransCard this month?
 1. afraid I would lose it
 2. did not know where to buy it
 3. no convenient outlet
 4. initial cost too high
 5. will not ride often enough (include vacation)
 6. changed job or residence (include unemployed)
 7. variable work schedule
 8. no reason
 9. other _____

12d. (IF 2 IN 12a) Why have you not bought TransCard?
 1. afraid I would lose it
 2. do not know where to buy it
 3. no convenient outlet
 4. initial cost too high
 5. do not ride often enough
 6. do not make work trips
 7. variable work schedule
 8. no reason
 9. other _____

13. null

14. null

15. (ASK FOR WORK TRIPS ONLY)
 15a. Would you buy TransCard if it were available through your employer?
 1. yes 2. no 3. it already is

15b. Employer's name _____

Resume Questions for All Respondents

16. What are the first three digits (exchange/pretz) of your telephone number? _____

17. Looking at the card, what letter matches your age bracket?
 A (1) under 16 E (5) 60-64
 B (2) 16-24 F (6) 65 and over
 C (3) 25-39 G (7) refused
 D (4) 40-59

18. Also on the card, what letter matches the combined annual income for your entire household?
 A (1) less than \$5,000 E (5) \$25,000-34,999 and over
 B (2) \$5,000-\$9,999 F (6) \$35,000 and over
 C (3) \$10,000-\$14,999 G (7) don't know
 D (4) \$15,000-\$24,999 H (8) refused

19. Including yourself, how many people are there in your household? _____

20. How many automobiles, vans, and light trucks are owned and operated by you and members of your household? _____

21. Are you eligible for the reduced fare for elderly and handicapped persons?
 1. yes 2. no

22. (BY OBSERVATION) Sex/Race of respondent
 1. WF 2. WM 3. BF 4. BM 5. OF 6. OM

MARTA TransCard/Integrated Fare Collection Evaluation Project-Rail On-Board Survey Questionnaire

Form Number _____ Station _____
 Inbound (1)/Outbound (2) _____
 Time _____ AM/PM _____

Interviewer _____ Edited by: _____
 Hello, I work for MARTA and we're doing a survey to obtain information to help serve our riders better. May I ask you a few questions. None of the information you give me can be traced back to you as an individual.
 _____ Refused _____ Transfer _____

Questions for All Respondents

1a. How did you pay your fare when you entered the station?
 1. Cash 2. Transfer 3. TransCard 4. Other _____

1b. (CASH FARE ONLY) What was the amount of the fare? _____
 1. Regular 2. Student 3. Elderly/Handicapped 4. Other _____

2. Before beginning this trip, where did you come from?
 1. home 2. work 3. school 4. shop 5. personal business 6. social-recreational 7. church 8. other _____

3. At what station are you boarding the train? _____

4. What kind of place are you going to?
 1. home 2. work 3. school 4. shop 5. personal business 6. social-recreational 7. church 8. other _____

5a. Will you have to transfer to get there?
 1. no 2. yes-to bus

5b. (CONTINUE FOR PEOPLE WHO TRANSFER ONLY) How many transfers will you make? _____

5c. At what station will you leave the train? _____
 (PEOPLE WHO TRANSFER TO/FROM RAIL ONLY)
 On a scale of one to five, with one being very good and five being very poor, how do you rate the convenience of transferring between bus and rail?
 1. Downtown? _____
 2. In the suburbs? _____

6. What are your specific problems in or comments on transferring between bus and rail? _____

7. If you did not ride MARTA how would you make this trip?
 1. carpool all the way 2. carpool to MARTA station 3. kiss-ride to MARTA station 4. drive car all the way 5. drive car to MARTA station 6. ride with someone all the way 7. ride with someone to MARTA station 8. walk 9. bicycle 10. taxi 11. would not make trip 12. other _____

8. How did you get to the station to begin this trip?
 1. walk 2. drive by myself 3. drive with passenger(s) 4. bicycle 5. ride with someone 6. other _____

9a. How many times did you use MARTA to GET TO WORK last week? _____

9b. How many times did you use MARTA to GO HOME FROM WORK last week? _____

9c. In addition, how many other ONE-WAY trips did you make on MARTA last week? _____

9d. Was your travel by MARTA last week typical of your normal use?
 1. yes 2. no
 IF NO, what is typical? _____ more or _____ less

10. How long have you been riding MARTA?
 _____ years/_____ months

11. Were you a regular MARTA rider before rail service was begun?
 1. yes 2. no

Questions for TransCard Respondents Only

12a. How long ago (when) did you buy your first TransCard?
 _____ months ago or _____ 19____

12b. How often have you bought TransCard since then? _____ months
 1. every month (100%)
 2. nearly every month (80-99%)
 3. most months (60-79%)
 4. some of the time (40-59%)
 5. rarely (less than 40%)
 6. this is the first month
 7. other _____

12c. (IF NOT 1 or 6 IN 12b) Why have you not bought TransCard every month?
 1. afraid I would lose it
 2. did not know where to buy it
 3. no convenient outlet
 4. initial cost too high
 5. did not ride often enough (include vacation)
 6. changed job or residence (unemployed during period)
 7. variable work schedule
 8. no reason
 9. other _____

13. Were you a regular MARTA rider before buying TransCard?
 1. yes 2. no

14. Why do you buy TransCard? (1 first reason-2 second reason)
 1. allows stopovers 2. saves money 3. pay only once each month 4. easier/faster to get on bus or train
 5. more convenient/no change needed 6. makes transferring easier

15. (ASK FOR WORK TRIPS ONLY) Would you prefer to buy TransCard through your employer?
 1. yes 2. no 3. already do

15b. Employer's name _____

Questions for Cash/Transfer Respondents Only

12a. Have you ever bought TransCard?
 1. yes 2. no 1. What is TransCard (IF YES) first time: _____ 19____ (month)

12b. (IF 1 IN 12a) How many times have you bought TransCard? _____ months
 1. null
 2. nearly every month (80-99%)
 3. most months (60-79%)
 4. some of the time (40-59%)
 5. rarely (less than 40%)
 6. null
 7. other _____

12c. (CONTINUE FROM 12b) Why did you not buy TransCard this month?
 1. afraid I would lose it
 2. did not know where to buy it
 3. no convenient outlet
 4. initial cost too high
 5. will not ride often enough (include vacation)
 6. changed job or residence (include unemployed)
 7. variable work schedule
 8. no reason
 9. other _____

12d. (IF 2 IN 12a) Why have you not bought TransCard?
 1. afraid I would lose it
 2. do not know where to buy it
 3. no convenient outlet
 4. initial cost too high
 5. do not ride often enough
 6. do not make work trips
 7. variable work schedule
 8. no reason
 9. other _____

13. null

14. null

15. (ASK FOR WORK TRIPS ONLY) Would you buy TransCard if it were available through your employer?
 1. yes 2. no 3. it already is

15b. Employer's name _____

Resume Questions for All Respondents

16. What are the first three digits (exchange/prefix) of your telephone number? _____

17. Looking at the card, what letter matches your age bracket?
 A (1) under 16 B (2) 16-24 C (3) 25-39 D (4) 40-59 E (5) 50-64 F (6) 65 and over G (7) refused

18. Also on the card, what letter matches the combined annual income for your entire household?
 A (1) less than \$5,000 B (2) \$5,000-\$9,999 C (3) \$10,000-\$14,999 D (4) \$15,000-\$24,999 E (5) \$25,000-\$34,999 and over F (6) \$35,000 and over G (7) don't know H (8) refused

19. Including yourself, how many people are there in your household? _____

20. How many automobiles, vans, and light trucks are owned and operated by you and members of your household? _____

21. Are you eligible for the reduced fare for elderly and handicapped persons?
 1. yes 2. no

22. (BY OBSERVATION) Sex/Race of respondent
 1. WF 2. WM 3. BF 4. BM 5. CF 6. CM

APPENDIX B. STATISTICAL FORMULAS

APPENDIX B

STATISTICAL FORMULAS

This appendix presents the formulas used to compute t-statistics which can be used to test the hypothesis that two means (or two proportions) are statistically different from each other with a certain confidence limit. The t-statistic to test the hypothesis that there is no difference between two means is:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

where:

- \bar{X}_1 = Sample mean, cash users
- \bar{X}_2 = Sample mean, TransCard users
- σ_1 = Standard deviation, Cash users
- σ_2 = Standard deviation, TransCard users
- n_1 = Sample size, cash users
- n_2 = Sample size, TransCard users

The following test for proportions was used to test for differences in the sex and race variables only:

$$t = \frac{\sqrt{N} [N_1^C N_2^t - N_1^t N_2^C]}{\sqrt{N_1^C N_2^C N_1^t N_2^t}}$$

where:

	Cash	TransCard	
Market segment 1	N_1^C	N_1^t	N_1
Market segment 2	N_2^C	N_2^t	N_2
	N^C	N^t	N

and;

- N_1^C = Number of Cash users within Market Segment 1
- N_1^t = Number of TransCard users within Market Segment 1
- N_2^C = Number of Cash users within Market Segment 2
- N_2^t = Number of TransCard users within Market Segment 2
- N_1 = $N_1^C + N_1^t$
- N_2 = $N_2^C + N_2^t$
- N = $N_1 + N_2$

APPENDIX C. COMPARISON OF FINDINGS BETWEEN
THE ATLANTA AND OTTAWA TRANSIT PASS PROGRAMS

TABLE C-1. COMPARISON OF FINDINGS
BETWEEN OTTAWA AND ATLANTA

<u>Finding -- Ottawa*</u>	<u>Finding -- Atlanta**</u>
1. Ridership growth after pass introduction occurred among pass users.	Same
2. High degree of public acceptance of pass.	Not specifically examined, but probably same.
3. Pass purchasers tended to be regular peak period users.	Pass purchasers tended to be regular bus commuters.
4. Cash users tend to make fewer peak and weekend bus trips.	Not tested.
5. Pass purchasers increased number of off-peak bus trips, but not peak and weekend bus trips.	Pass users increased both work (peak) and nonwork (off-peak) trips, with proportionately larger increase for nonwork trips.
6. Pass users who stopped buying stopped using bus entirely.	About the same.
7. Those who increased number of peak period trips tended to be less frequent riders.	Basically same result.
8. Car availability did not affect decision to purchase pass.	People with auto available tended to be less likely to purchase pass.
9. Pass purchasers with car available made fewer weekend and off-peak bus trips.	Basically, same result.
10. Car availability had no effect on number of peak bus trips made by pass users.	Pass purchasers with car available tended to increase number of work bus trips per week.
11. Public far more attracted to convenience of pass than by potential cost savings.	Opposite effect noted.

*The Bureau of Management Consulting, The Ottawa Bus-Pass System -- An Examination of Effects. Prepared for the Urban Transportation Research Branch, Transport Canada, Montreal, September 1977.

**From calculations performed by Charles River Associates.

APPENDIX D. REPORT OF INVENTIONS

APPENDIX D

REPORT OF INVENTIONS

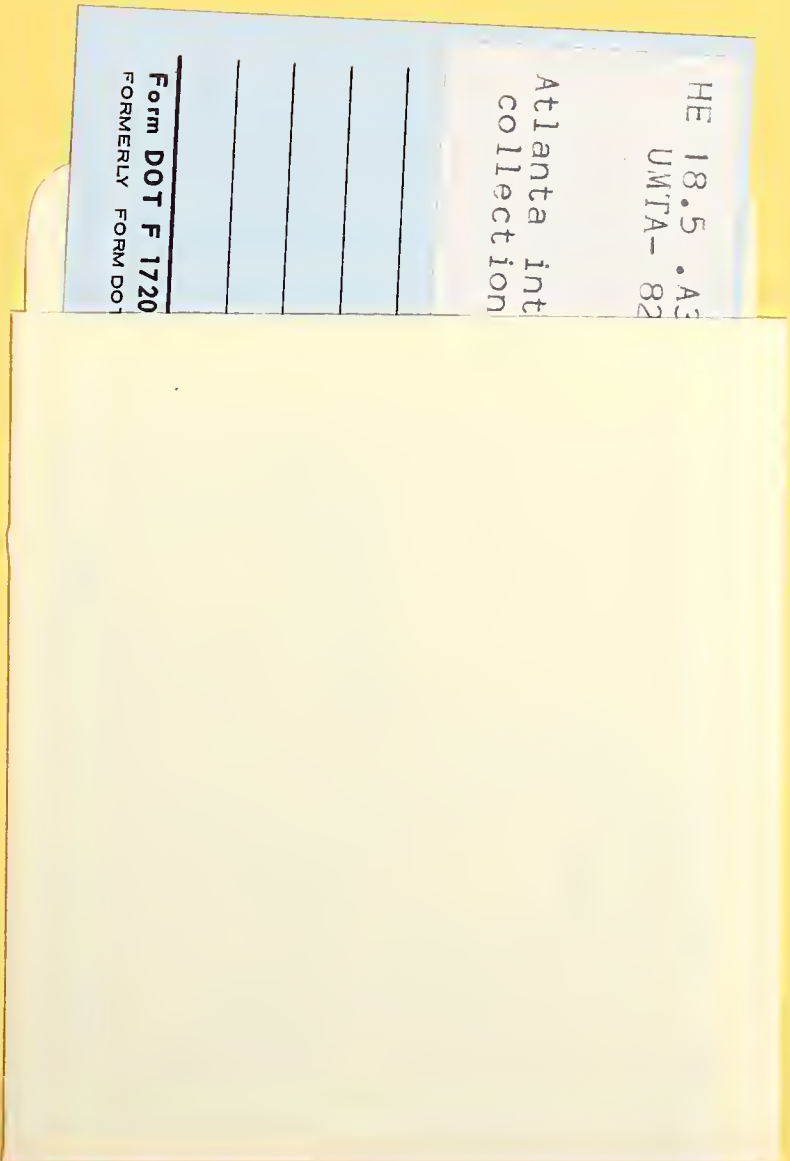
The work performed under this contract, while leading to no new inventions, has provided useful information and insights that can be used by transit properties interested in implementing or evaluating their own transit pass programs.

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