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## Evaluation of Interpersonal Influences in the Formation and Promotion of Carpools

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A three-phase analysis of the role of interpersonal factors in carpooling performed at the University of Iowa is described. Phase 1 used laboratory simulation methods in which respondents rated the relative desirability of alternative carpool descriptions. The desirability of carpooling was found to decrease as the number of nonacquaintances in the pool increased, and particularly low ratings were given to carpools that consisted wholly of nonacquaintances. In phase 2, attitudinal and behavioral data from an existing industry-based carpool promotional program were analyzed by using Federal Highway Administration matching techniques. The data confirmed the importance of acquaintanceship as a factor in carpooling. Phase 3 used the findings from phases 1 and 2 to design and implement promising strategies for promoting carpooling. Strategies that stressed person-to-person contact between potential carpoolers and used existing networks of acquaintanceship to increase the number of carpools were emphasized. It is concluded that evaluation of such strategies should be useful in formulating future carpool promotional programs.

Over the years, transportation researchers have increasingly come to realize the importance of social factors in travel decisions. In particular, the choice of a multioccupant mode, such as carpooling, for the journey to work involves interpersonal as well as economic factors. Programs designed to increase carpooling must take this into account. The goals of this paper are to advance some ideas about the role of interpersonal factors in ride sharing and to show how these ideas can be used to promote carpooling.

Hartgen (1), Horowitz and Sheth (2), Kurth and Hood (3), Levin and others (4), and Margolin and others (5) all view ride sharing as a psychosocial process. Hartgen's review of recent findings leads to four hypotheses for why ride sharing is not very common: (a) Carpoolers have unique trip and travel needs, (b) solo

drivers lack the information needed to form carpools, (c) attitudes of carpoolers are different from those of solo drivers, and (d) the social processes involved in carpooling are difficult for solo drivers to overcome. Hartgen (1) reports that Margolin and Misch used decision analysis panels in the Washington, D.C., area to develop hypotheses about ride-sharing motivation and found that the factors that deter people from carpooling include a desire to maintain independence, concern over waiting for others, and personal incompatibilities with other members of the pool. Among the more interesting data in the study by Margolin and Misch on interpersonal factors were that 87 percent of their commuters wanted to meet prospective members before making any ride-sharing arrangements and 39 percent felt that they would have to know the people first. Since traditional carpool matching programs ultimately leave it to the individual participant to contact other potential ride sharers on a list, a reluctance to contact strangers can be a major problem in forming carpools.

The carpooling research program at the University of Iowa (4, 6, 7) is based on the premise that a thorough understanding of the individual decision processes and attitudes that underlie ride-sharing behavior is a prerequisite for designing and implementing effective carpooling programs. Thus, the analysis consists of three phases: (a) laboratory simulation studies of the influence of interpersonal factors on attitudes toward carpooling, (b) analysis of attitudinal and behavioral data from existing carpooling programs, and (c) design, implementation, and evaluation of potentially effective strategies for promoting carpooling.

**Table 1. Study response on likelihood of carpooling in carpools of certain characteristics.**

Characteristic	Likelihood of Carpooling (mean rating)	
	Males	Females
Daily savings* (cents)		
20	7.1	7.0
50	8.9	8.6
Additional travel time* (min)		
10	10.9	10.2
30	5.1	5.4
Acquaintanceship among riders		
No acquaintances		
Two males	6.2	5.6
One male, one female	7.0	7.0
Two females	7.2	7.5
One acquaintance		
One male nonacquaintance, one male acquaintance	7.8	7.5
One male nonacquaintance, one female acquaintance	8.1	8.2
One female nonacquaintance, one male acquaintance	8.2	8.1
One female nonacquaintance, one female acquaintance	8.4	8.3
Two acquaintances		
Two males	9.1	8.2
One male, one female	8.9	8.5
Two females	9.0	9.2

\*Specified as difference between driving alone and carpooling to work with two other people.

## LABORATORY SIMULATION STUDIES

Hypothetical carpool formations were described by varying the number of riders in the pool, the gender of each rider, and whether or not each rider was a prior acquaintance of the respondent (4). Respondents then rated the desirability of each alternative carpool formation. These ratings can be summarized as follows:

1. Ratings increased as the number of acquaintances in the pool increased. The lowest ratings were given to carpools in which there were no acquaintances. Even one acquaintance in the pool raised the ratings to above neutral.
2. Both male and female respondents rated carpools with female riders higher than carpools with male riders.
3. The gender of riders did not affect carpool desirability ratings as much when the riders were acquaintances as when they were nonacquaintances. When the rider was an acquaintance, gender did not matter; when the rider was a nonacquaintance, both male and female respondents preferred female riders.

A second study (4) extended these results by showing that they hold when cost and time factors as well as interpersonal factors are considered. In the second study, hypothetical carpool formations were described by varying rider characteristics, cost savings for carpooling versus driving alone, and additional travel time for carpooling. These results are given in Table 1.

The data show that, on a 15-point scale of rated likelihood of joining a carpool, ratings were about 1.7 points higher when the daily savings were 50 cents than when they were 20 cents and about 5 points higher when the additional daily travel time was 10 min than when it was 30 min. In addition, ratings varied by about 3 points as a function of rider characteristics. Rider characteristics thus had effects comparable to those of cost and time factors. As shown by Levin and others (4), the most parsimonious model of the effects of rider characteristics on the desirability of a given carpool

is as follows: The desirability of a carpool is an average of the desirability levels of the individual riders, the desirability of a given rider being a joint (multiplicative) function of gender and acquaintanceship. The main implication of this averaging model is that a desirable carpool mate (i.e., an acquaintance) can compensate for an undesirable carpool mate (i.e., a nonacquaintance) and lead to a carpool formation of at least moderate desirability. We will return to this point later when we discuss methods of increasing the desirability of carpools.

Results of the laboratory simulation studies thus led us to believe that interpersonal factors are comparable in importance to more traditionally studied cost and time factors in carpooling and, in particular, that acquaintanceship is a potent factor that should be incorporated into strategies for promoting carpooling. To be sure, other interpersonal factors, such as commonality of interests, occupation, and age, can be shown to play a role in the desirability of joining a carpool. However, many of these factors can be subsumed under acquaintanceship; for example, people with contrary interests will not likely become good acquaintances. In fact, this easy-to-operationalize factor may be a good surrogate for a cluster of other interpersonal factors. Thus, the next step in the study of interpersonal factors in carpooling was an investigation of the role of acquaintanceship in an existing program of carpool promotion.

## EVALUATION OF AN EXISTING CARPOOLING PROGRAM

In phase 2 of the research, an industrial firm that was in the process of initiating a carpooling promotional program was surveyed. The firm was interested in promoting carpooling because it wanted to expand its facilities and increase the number of its employees without having to set aside valuable space for additional parking. The company strongly encouraged ride sharing through frequent newsletters and memorandums, newspaper and television advertisements, and a widely publicized press conference at which the start of a ride-sharing program was announced. [Additional information about this program is provided in reports by Dueker and others (8) and Levin (9).] A Federal Highway Administration origin-destination matching program was used to provide lists of names and addresses to 91 employees matched according to work schedule, work location, and home address within a 2.5-km<sup>2</sup> (1-mile<sup>2</sup>) area. From these, only two new carpools were formed and one existing carpool was enlarged, but 10 of the people on the lists joined carpools with people who were not on the lists.

Six months after the promotional program was initiated, a questionnaire was administered to all 1900 employees, of which 1325 (70 percent) were returned. Separate sets of questions were designed for carpoolers and noncarpoolers. The crucial items for noncarpoolers were (a) a checklist of reasons for not carpooling and (b) an indication of whether or not the respondent was interested in carpooling. The crucial items for carpoolers were (a) ratings of the importance of various reasons for carpooling and (b) a description of the current carpool, including names of riders, how well acquainted each rider was with the respondent before formation of the carpool, distance from riders' homes to the respondent's home, and an indication of who contacted whom to initiate formation of the carpool.

An initial hypothesis based on the laboratory studies [and on other research, including that done by Margolin and others (5)] was that employees would be reluctant

**Table 2. Study response (percentage of respondents) on importance of reasons for carpooling based on distance between riders.**

Reason for Carpooling	Degree of Importance	Distance Between Riders		
		1.6 km	3.2-8 km	≥9.6 km
Save money	Very important	60	74	83
	Important	32	10	17
Conserve energy	Very important	52	42	61
	Important	41	47	39
Share driving	Very important	31	26	50
	Important	32	37	9
Enjoy company	Very important	26	26	35
	Important	40	32	35
Family needs the automobile	Very important	15	16	13
	Important	14	5	9

Note: 1 km = 0.62 mile.

to initiate contact—the first crucial step in forming a carpool—with strangers. Two aspects of the data supported this hypothesis. Although 35 percent of the respondents indicated that they were carpooling, only 1 percent indicated that they had begun carpooling as a result of the program. The most important result in relation to the carpoolers was that more than two-thirds of them were at least fairly well acquainted with their fellow carpoolers before pooling began. Only 15 percent did not know one another at all before carpooling. The data on acquaintanceship are summarized in the table below:

Degree of Acquaintanceship	Number of Males	Number of Females	Total	
			Number	Percent
Very well acquainted	278	12	290	39
Fairly well acquainted	206	9	215	28
Slightly acquainted	127	5	132	18
Not at all acquainted	102	7	109	15

We also attempted to trace the sequence of contacts involved in setting up a carpool by asking respondents to list their fellow carpoolers and indicate who contacted whom. Among acquaintances the process was apparently rather casual; quite often person A would indicate that he or she contacted person B but person B would say the opposite.

Whereas half of the riders in a given carpool lived within 3.2 km (2 miles) of each other, 16 percent lived more than 16 km (10 miles) apart. Table 2 summarizes the importance of various reasons for carpooling as a function of distance between riders. The farther riders lived from each other, the more important they rated cost savings and energy conservation as reasons for carpooling. In addition, a large percentage of carpoolers rated enjoying the company of others and sharing the driving as important reasons for carpooling. Thus, there appear to be some perceived social as well as economic and energy-conserving advantages to carpooling.

The table below summarizes the data for noncarpoolers by comparing the reasons for not carpooling indicated by those interested and those not interested in carpooling:

Reason	Number Not Interested	Number Interested
Carpooling would be too time consuming	111	7
No one has contacted me	36	84
Wouldn't save enough money	146	10
Don't like to contact strangers	33	14
Need the automobile	282	21

Most noncarpoolers (74 percent) indicated that they were not interested in carpooling. The primary reason seems to be a need for the automobile during or after

working hours. Of those who did not enter carpools but indicated that they were still interested in carpooling, the primary reason for not having joined a carpool was lack of contact with other potential carpoolers. In other words, the crucial initial contact had not been made.

In summary, analysis of this promotional program reinforced earlier views of attitudinal differences between carpoolers and noncarpoolers and the role of interpersonal factors in ride sharing. Much of whatever success the program had could be attributed to promotion aimed at increasing employee awareness of the desirability of ride sharing. This presumably encouraged people to talk with their friends about the feasibility of sharing rides. But very few people took the initiative to call strangers whose names were supplied on a computer-generated matching list.

Most noncarpoolers had strongly felt reasons for not carpooling; this group is therefore probably not a good target for promotional programs. A sizeable number of employees, however, appear to be interested in carpooling but do not contact strangers to initiate formation of a carpool. These people would constitute the ideal group for the application of promotional strategies that use the "personal touch" to overcome problems with traditional matching techniques. Several such strategies are described in the following section.

## PROMOTIONAL STRATEGIES

A 1976 evaluation of existing carpool incentives and disincentives by the Federal Energy Administration (FEA) (10) distinguishes successful from unsuccessful strategies. On the whole, incentives are recommended over disincentives. These include carpool matching and promotion, vanpools and buspools, preferential parking, and parking subsidies. The current view is that carpooling promotional programs should include such incentives wherever possible but go beyond those recommended by FEA by making carpooling socially desirable as well as economically advantageous.

The three strategies described below are the result of consideration of our laboratory findings that carpools that consist of all nonacquaintances are of low desirability and our study of actual carpool formation, which showed that very few people initiated contact with nonacquaintances on their matching list.

### Chaining

In the laboratory study, the desirability of carpooling decreased as the number of nonacquaintances in the pool increased, but even one acquaintance in the pool raised the level of desirability to above neutral. Thus, attempts should be made to ensure that each potential carpooler knows at least one person in the pool. Lists of potential carpoolers would be drawn from, for ex-

ample, employees of large firms who have the same work schedules and destinations. Since the study of carpool formation showed that carpoolers often live far apart, home addresses would be matched only roughly in terms of possible routes to be taken to work. Each member of the list would be asked to identify acquaintances on the list with whom he or she would be willing to carpool. Acquaintanceship networks would be examined to form "chains". A chain of the form A-B-C-D would be optimal where person A knows person B, B knows C, and C knows D. In such a chain, each person would have at least one acquaintance in the carpool. B and C could serve as the contact persons to organize the pool because they would never have to contact a stranger. Even a pool of the type A-B, C-D would have the desirable property that each person would know one other person in the pool; however, identifying a "contact person" would be more difficult in this case (see the discussion of this point below).

The main practical problem that we discovered with the chaining strategy is that there must be a large number of people on the original lists before new chains can be formed, especially since most carpools are already based on acquaintanceship networks. However, people who do not know each other quite well enough to have initiated carpools on their own or who did not realize that they lived along the same corridor might well be influenced by the chaining strategy.

#### Face-to-Face Contact

A major reason for the limited success of existing matching and promotional programs is that individuals are ultimately left with the responsibility of contacting others—usually strangers—to initiate the formation of a carpool. A work setting would be the ideal place to bring together interested people who have been identified as potential carpoolers on the basis of origin-destination matching (broadly defined). This might require no more than a 20-min coffee break during which potential poolers could meet each other, "break the ice", and then discuss subjects such as cost sharing, driving rotation, and optimal routes as well as ground-rules on smoking, playing the radio, conversation (e.g., no "shop talk"), and whether the carpool would make stops along the way for shopping or other purposes. In other words, more could be accomplished in one personal meeting than might be accomplished in several long and inconclusive dyadic telephone conversations. And, of course, those telephone calls might never be made because of reluctance to contact strangers.

One side benefit of this procedure could be that people who work in the same organization would recognize each other in person even if they did not recognize each other's names on a printed list. A major step in this procedure would be to obtain a coordinator who would arrange for the meeting, isolate different potential carpool groupings, and so on. In an industrial setting, someone like the personnel manager would be ideal for this purpose. This person would have to be convinced that the program's benefits to the company and its personnel would outweigh the time and effort involved. The researcher would have to provide detailed guidelines for ease of operation. Other suggestions regarding management's role in increasing ride sharing are provided in a report to the U.S. Department of Transportation by a team of researchers from the University of Tennessee (11).

#### Identification of Contact Person

As indicated, a major hurdle in forming a carpool is

ensuring that the initial contact between potential carpoolers is made. The chaining procedure accomplishes this by eliminating the need to contact strangers, and the face-to-face procedure brings people into direct personal contact rather than supplying lists and requiring telephone contacts between strangers. A less satisfactory, but much simpler, method is to identify a single contact person in each potential carpool. All carpooling programs require some sort of questionnaire or survey of potential participants. A simple expedient would be to include the following item: Would you be willing to telephone other people (on your list) to form a carpool? Although one could not assume 100 percent validity in positive responses to such a question, it is fairly certain that a grouping without any "yes" respondents is doomed to failure. Having identified one or more contact persons in a potential carpool grouping, the researcher or coordinator could then maintain contact with that person in order to monitor or encourage the carpool formation process.

Some of these strategies are currently being tried out in Cedar Rapids, Iowa. We are working with the personnel directors of the two largest hospitals in the city, who are interested in promoting carpooling to help their employees save money (many employees commute from long distances and do not make large salaries). The main problem in working with hospital personnel is that there are many different work shifts and a considerable amount of changing from one shift to another.

A one-page questionnaire was sent to each employee in his or her pay envelope. This questionnaire was an abbreviated version of the one described earlier for phase 2 of the research program; the major results concerning the reasons for carpooling and not carpooling were replicated. Individuals who were interested in carpooling on the basis of work schedule and route to work were then matched and provided with the opportunity for face-to-face meetings.

It is too early to assess the success of this effort, but one anecdote will serve to illustrate the various phases of the program and the inevitable frustrations encountered in promoting carpooling. One of our meetings was attended by three female employees who were friends and were already carpooling together but who wanted to find a male employee who would do the driving in bad weather. According to our laboratory study, the fact that there would be three female acquaintances in the pool would make it desirable for them, and the one male nonacquaintance would find it desirable to carpool with female riders. Despite this idyllic situation, we have not yet been able to find that one male who matches the women on work shift and driving route.

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## Technology Transfer in Paratransit: Five Case Studies

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The evolution and adaptation of paratransit from the perspective of technology transfer are examined. Three key factors in successful technology transfer and local adoption are the presence of necessary prerequisites (local paratransit-program mandates, a service patron, and entrepreneurial staff skills), the resolution of barriers (recognized as including local transportation planners, government agency staff, and federal programs and policies), and the transferability of the situation (unique local program or community characteristics that militate against the successful duplication of case study experiences). Five case studies are used to represent the major paratransit modes and mandates and substantial operating experience: the Seattle-King County Commuter Pool; the Knoxville Commuter Pool; Colonial Paratransit and Taxi Company of Bethel Park, Pennsylvania; Dial-a-Bat of Brockton, Massachusetts; and the Choanoke Area Development Association, Inc., of Murfreesboro, North Carolina. All five programs have evolved toward successful examples of technology adaptation and are characterized by broadly conceived mandates and multiple service activities. The case studies underscore the significance of the noted local prerequisites, particularly the role of the patron.

The principal objective of this paper is to examine the evolution and adaptation of five leading paratransit programs from the perspective of technology transfer. Examination of paratransit from this perspective provides new insights into the success and failure of local programs.

Successful local technology transfer and adaptation have occurred when the technology has been accepted in all its ramifications and has secured a stable role in the broader institutional milieu. For paratransit, this means operational transportation services that (a) serve a significant purpose that was previously not well served by other modes of transportation or institutions and (b) are accepted and supported by stable institutional structures.

Our interest in paratransit from the perspective of technology transfer arose from an Urban Mass Transportation Administration (UMTA) university research and training grant for the development of curriculum materials to support paratransit instruction in colleges and universities. A major element of these materials was five case studies of mature local paratransit

organizations that had successfully implemented paratransit services. All facets of service development were investigated so that they could be related to instructional concepts being developed. They thus represent prototypes of successful local technology transfer and adaptation in the paratransit field.

### CONCEPTS OF TECHNOLOGY TRANSFER

Technology transfer commonly includes two dimensions. The first is technology transfer in the sense of the evolution of a technology from conceptualization to broad practical application. In this process, a technology is perceived as "transferring" from one stage of development to another, and its overall evolution—generally described in terms of the number of units in operation (e.g., the number of carpools formed)—is presented by the familiar cumulative growth-decay, or S-shaped, curve (1).

In all cases, the model suggests an initial slow-growth phase; a rapid-growth, or adolescent, period; and a slow-growth, mature phase that leads to a no-growth point of equilibrium. The fundamental assertion of the model is that there are recognizable and predictable phases in the life of a technology that culminate at a point of eventual saturation or cessation of use. At that point the technology is generally succeeded by a technology that has greater utility or potential.

The second dimension of technology transfer is concerned with the interinstitutional diffusion of a technology and the process of its institutional adaptation. In this dimension of technology transfer, it is commonly held that there are three sets of factors that affect the local adoption of a new technology such as paratransit: the existence of key prerequisites for local adoption, the effective resolution of barriers to adoption, and transferability factors (unique local situations) that