

CUSTOMER PERSPECTIVES ON THE INTERIOR DESIGN OF URBAN BUSES

What features do people want in a transit bus

EXECUTIVE SUMMARY

Ben Barkow, Ph.D.

Behavioural Team

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A. BACKGROUND

In October, 1991, Behavioural Team was contracted by the Interior Bus Design Focus Groups Technical Committee of the Canadian Urban Transit Association to conduct Focus Groups to learn more about interior features which Canadians wished to see in transit buses.

Between October 16 and November 21, 16 professionally moderated Focus Groups were convened. Three types of riders were included in these 16 sessions:

- 8 sessions of *frequent riders*,
- 4 sessions of *not frequent riders*, and
- 4 sessions of persons with *physical limitations which slightly reduced their ease* of using transit buses.

A total of 133 people took part. The Study Guide of topics and timings for these discussions can be found in Appendix C.

Groups working in English met in Vancouver, Winnipeg, Brampton (a small city near Toronto), Toronto, Ottawa, and also in Montreal in French. Verbal data from discussions were augmented by written numeric data from:

- a brief survey and
- the *Transportation Adjective Checklist* [© Behavioural Team] a test for identifying transportation perceptions.

Discussions were held with the three largest Canadian bus manufacturers, MCI/Greyhound, New Flyer Industries, and Ontario Bus Industries and some insights were collected on the bus procurement process.

B. FINDINGS

1. BOARDING

1. Front entranceways were strongly criticized. Negative reactions applied to steps, handholds, door widths, provisions for the management of parcels and baby buggies, and congestion at the “nine point turn” near the fare box.

2. Design of the driver’s space and working with the driver was acceptable. Customers would not be displeased to see the driver seated in an ergonomic seat even if it appeared to be fancier than the usual transit standards.

2. ON THE BUS

1. There was a strong call for improved handholds. Most favoured were stanchions, with as many installed as possible in all parts of the bus; the front wheel well area should be included in adding stanchions. Overhead grab rails were unacceptable to many riders due to height although a suspended grip (such as a hanging “strap” mounted on an overhead grab rail) seemed to be an appealing idea to many.

2. Crowding and hence standing during trips is recognized as a fact of transit life among regular riders. From several convergent sources of evidence within this study, it appears that having a seat is not a top priority of riders, providing that the trip length is reasonably short.

3. Seats generated many negative reactions for their spacing, size, and surface treatment. There was widespread favourable recollection of the “old” upholstered seats which had springs. Smooth seats which are unable to stop riders from sliding about when the bus lurches were especially denigrated.

4. Riders strongly desire improved control of their climate and ventilation. Thus improved ventilation (both window-borne and forced) is identified here as a very important vehicle design effort. Buses are judged too hot in the winter and many respondents felt that the transit property had it in its power to serve them better.

5. Allowing for limitations of the Focus Group method in addressing this issue, riders do not appear inclined towards air conditioning. For the cities studied and with conventional urban routes in mind, they do

not express a strong need for cooling. Moreover, some riders are sensitive to the cost and environmental losses perceived to be associated with urban bus air conditioning. Past experiences with A/C (sometimes in rail transit settings) have not been favourable in terms of breakdowns, comfort, loss of operable windows as a back-up, or of change to the character of their transit milieu. These are perceptions which are held widely and they may or may not be applicable to current bus manufacture. This suggests that the implementing of A/C on transit buses should include an information campaign that addresses environmental and financial concerns of customers.

6. Noise such as window rattles and engine roar were mentioned. But noise does not appear to be more than a minor concern in most cities or a very major concern in any.

3. ALIGHTING

1. Orientation, or knowing where you are on your route and your proximity to your stop, appears to be major unfulfilled design issue. As previous studies have shown, it is all too easy to over-estimate the familiarity of riders with transit procedures and routes and thus to fail to adequately meet their information needs.

2. Exiting from the rear door was criticized in the same terms as boarding at the front. Door size, handholds, and steps were the main problems. In addition, there is considerable uncertainty about how the door control logic works and the degree to which drivers can surveil the back of the bus.

C. KEY FINDINGS AND RECOMMENDATIONS

In light of rider reactions, the following issues merit the earliest design attention.

Level change and door operations

The large risers on the steps used for entering and leaving buses are difficult for some customers to manage. The front steps need design improvement as well for handholds. The rear door and the mechanisms of control are also considered important for improvement.

Seats

Riders want to have better seats. The seats should offer help stabilizing against vehicle motions. The seats should be padded or better,

upholstered. A large number of respondents felt there was insufficient knee room.

Ventilation

Improved ventilation (both window arrangements and mechanical ventilation) is a design change deemed of great importance to the study participants. This may require separately controlled systems for drivers and passengers.

Orientation

There is a clear need for improved customer route orientation. This can range from more access to printed route maps to AVM-keyed automated announcements.

I INTRODUCTION

A. THE IMPORTANCE OF CUSTOMER SATISFACTION

Good reputation depends on customer satisfaction and as with any retail operation, good service and customer satisfaction is the foundation of success. On the other side, you can't alienate too many people for too long and expect to stay in business.

One aspect of transit service is the "rolling stock" of equipment. In turn, the greatest share of travel is done on transit buses. Therefore, it is important to provide transit buses which approach the expectations of customers.

What features do Canadians wish to see incorporated in their transit buses?

B. INCREASING CUSTOMER SATISFACTION THROUGH DESIGN

1. DIRECT EFFECTS OF DESIGN

The direct effects of having behavioural information relating to good design are...

- increased satisfaction of customers because perceived needs for psychological aspects such as sitting comfort, ventilation, and orientation to the route are met,
- better utilization of existing stock,
- increased sense of safety and reduced liability to the transit property,
- optimized vehicle expenses because features of small importance are omitted in favour of features which are sought by a broad spectrum of the public, and
- increased ridership, increased public support, and decreased animosity towards the property.

At the end of the Focus Groups — 90 minutes of talking about bus interior design — a brief questionnaire was distributed. In this report, whenever information from the mini-survey is being presented, **boldface type** will be used.

The first question requested respondents to complete the sentence, “The best thing about traveling in city buses is...”

91% of the 116 respondents who attempted this question mentioned something to do with operations and 5% (including some possible overlap with the first group) indicated operator service considerations. This totals 111 answers praising operations or service.

By contrast, of all the answers made by the participants, only 11 praised any aspect of interior design, and by contrast, answers to the question about “worst thing” were far more liberally related to interior design concerns. Operations and service account for 43 answers while interior design issues (which include crowding) account for 136.

2. INDIRECT EFFECTS OF DESIGN

a) INDIRECT EFFECTS RELATED TO OPERATIONS

But good design (based on customer behavioural information) has indirect benefits because it leads to informed and economic decision making on the part of procurement officials. For example, properties make purchasing decisions of the following kinds...

- *big doors* allow for shorter dwell times at stops although they reduce the number of seats or standing room, and
- *innovations in braking* allow faster stops with less passenger injury.

Judgments underlying such decisions are wiser when passenger preference and ergonomic data is available.

b) INDIRECT EFFECTS RELATED TO STAFF BEHAVIOUR

Likewise, bus design influence operator performance. A bus which is small or easy to drive may allow a property to select operators for professional skills besides vehicle handling skills. Comfortable workstations and power steering help the operator keep performing more effectively in his or her driving role *as well as more*

courteously in his or her customer relations role for longer periods of time.

C. THE STUDY MANDATE

The objectives of this project were stated in the *Terms of Reference* as follows.

“... to explore, through the use of focus group market research tools, and synthesize, issues related to the interior design of conventional urban buses, from the perspective of customers.

“... to identify and classify... from the perspectives of customers, to explore factors that may affect the relative priority of issues..., and to provide recommendations for further research or actions.

“... it is clear that this study is only an initial step in a more comprehensive issue.”

II METHODS

A. DATA FROM THE PUBLIC

1. SPOKEN DATA

a) WHAT IS A “FOCUS GROUP?”

Focus Groups are invaluable in order to get a very personal, credible sense of how people feel about something. A description of Focus Group technique appears in Appendix B.

Focus Groups are open-ended in format but — when professionally moderated — they are *not* aimless discussions or opportunities to vent hostilities. They are structured and, to the degree possible, unbiased and representative. This is accomplished by devising a productive Study Guide, assigning discussion times to topics (and keeping to these timings!), and through the selection of respondents.

Unless clear and unanimous views are expressed, they ordinarily must be followed by more structured and denotative research such as tests of mock-ups, individual interviews, rating scales, semantic differential tests, factor analytic methods, ergonomic measurements, or behavioural observations.

b) THE STUDY GUIDE

The Study Guide can be found in Appendix C.

In creating the Study Guide, a reasonable spread of attention to major topics in interior design of transit buses was the goal. However, fare payment was specifically omitted, to be examined separately and more comprehensively another time.

It proved to be very helpful to enforce adherence to the normal flow of behaviour in setting the discussion topics. That is, discussion started with boarding and ended with alighting.

2. WRITTEN DATA

a) THE TRANSPORTATION ADJECTIVE CHECKLIST

The session started with administration of the *Transportation Adjective Checklist* [© Behavioural Team] a test for identifying transportation perceptions. The TACL, shown in Appendix C, lists 181 words broadly applicable to a range of transportation modes. Respondents were encouraged to think of *transit* buses in making their choices of words. (The TACL shown in Appendix C is a reformatting of the original 14 inch length for convenience of reproduction in this report.)

Data from the TACL have been collected for several modes of travel and it was felt that it would be useful in this project. Behavioural Team who developed the TACL (and a related test called the "Building Adjective Checklist" which is used to evaluate buildings), offer it free to researchers with the understanding that all data sheets will be submitted to Behavioural Team for scoring and analysis.

b) THE MINI-SURVEY

At the end of each session, a short survey was administered. It has four components...

- open ended questions including features liked and disliked,
- 11 five point rating scales of features in buses, e.g. wide rear doors; these scales were scored from 5 (very important) through 3 (neither important nor unimportant), to 1 (very unimportant),
- an evaluation of the willingness of the respondent to board and to be without a seat on a crowded bus or to choose to wait for the next bus which would permit seated travel: this was analyzed in terms of bus headways versus trip length, and
- basic demographic facts of the respondent including sex, age, height, frequency of travel, and disabilities relevant to transit use.

Information from the survey is discussed where appropriate below. In general, there were few differences among groups or genders. In

some instances below, differences are mentioned or, where the reader might be curious, the *absence of* differences is specifically pointed out.

3. SAMPLES OF RESPONDENTS

Care is needed in determining the most productive mix of respondents in *each* Focus Group meeting. The mix of respondents affects the quality of the discussions. It influences the analysis of the audio tapes because responses cannot be separated out between contrasting groups (say, *frail* versus *non-frail* riders) by voice if they were to be mixed in the same group.

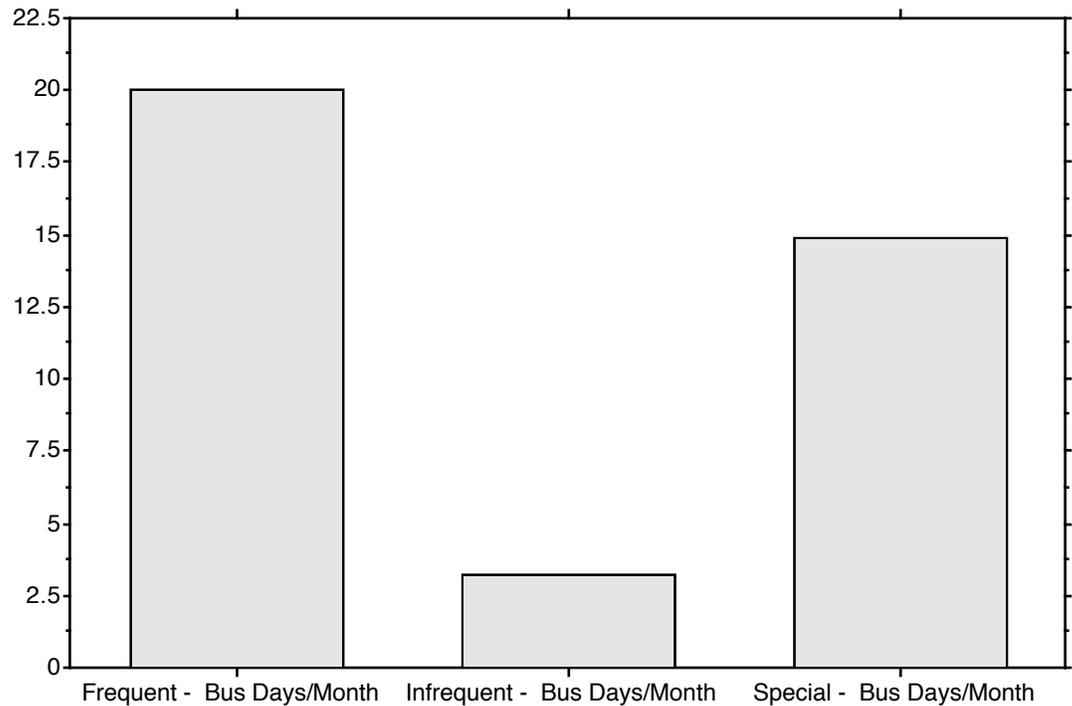
The screener survey used for selecting Focus Group participants can be found in Appendix C2. It was determined to organize three types of groups. All told, a total of 133 individuals took part...

Frequent transit users, 63 participants >50 times a year (aver. 233/yr.)	8
groups (6 Eng., 2 Fr.)	

Infrequent, 33 participants <50 times a year (aver. 38/yr.)	4
groups (3 Eng., 1 Fr.)	

Special needs (travel with mild degree of difficulty), 37 participants familiar with transit (aver. 172/yr.)	4
groups (3 Eng., 1 Fr.)	

The frequency of use of the three groups is shown in the chart below.



This division allowed increased attention to the frequent user while being able to collect solid information from infrequent and special needs groups.

Respondents in Frequent and Infrequent sessions were 16 to 64 years of age. Anyone over 65 was deemed eligible for the Special needs group, although an effort was made to find respondents who did experience some problem. Visually, hearing, and physically limited individuals of all ages were included in the Special needs groups.

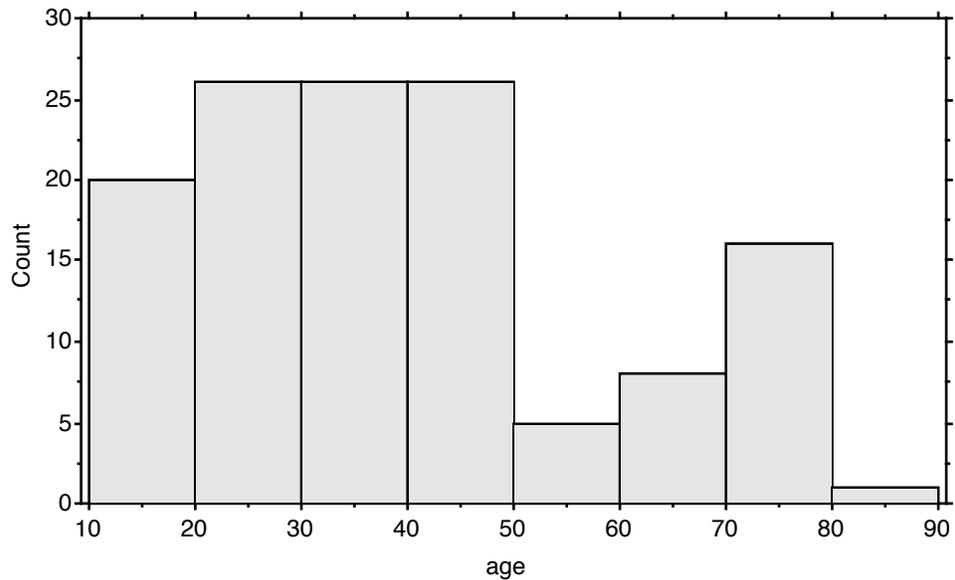
On the survey was a question which asked, "If you have a disability which hinders your use of city buses...." Disabilities among participants are as follows.

frail	17%
walking	4%
vision	2%
neuro-motor	2%
other	2%
multiple	2%
hearing	1%
"none" (or no answer)	72%

As shown in the table above, only a single person indicated that they had a hearing disability. But a greater number of hearing aids were visibly in use at the sessions. Apparently the qualification “which hinders your use of city buses” was understood by respondents to mean, “which *seriously* hinders....”

A special effort was made to ensure comparable representation for men and women. 64 men and 65 women took part and another four individuals did not classify themselves by gender. Of these 133, men averaged 38.1 years of age and the women 40.7.

The chart below shows the distribution of ages of respondents in 10 year intervals. The shape of the chart reflects the separation of older travelers into separate sessions.



Finally, a special effort was also made during the screening process to ensure that both Frequent and Infrequent groups included participants with experience traveling by transit with small children.

In all relevant respects examined, the English and French groups were quite parallel. In consideration of the small size of the groups and the similarity of their reactions, no separation of data into language groups is attempted in this report. Of course, identifying the city or language session which is the source of a particular insight sometimes is used to enrich the narrative below.

4. SAMPLE OF CITIES AND SESSION DETAILS

Six cities were selected for test sites. Except as noted each city had a total of two sessions.

Vancouver	Frequent Special
Winnipeg	Frequent Special
Brampton (193,000 population)	Frequent Infrequent
Toronto	Frequent (two groups) Infrequent Special needs
Ottawa	Frequent Infrequent
Montreal (in French)	Frequent (two groups) Infrequent Special needs

Sample distribution by city is shown in the following table.

X₁ : City

Bar:	Element:	Count:	Percent:
1	Toronto	33	24.8%
2	Brampton	13	9.8%
3	Vancouver	18	13.5%
4	Winnipeg	19	14.3%
5	Montreal	35	26.3%
6	Ottawa	15	11.3%
7	Other	0	0%

- Mode

As is customary, groups met at 6 PM or 8 PM. An honourarium of \$25 was paid to each respondent although for Vancouver and Winnipeg, Special needs travelers received \$30. In Winnipeg, cab fare was offered to some Special needs travelers because of the unseasonably cold weather which descended on town just before the Grey Cup weekend.

Sandwiches and deserts were served for the 6 PM groups and cookies and drinks for all groups.

B. OTHER DATA

1. DESIGN AND PROCUREMENT OF BUSES

a) DISCUSSIONS WITH MANUFACTURERS

The design of the project provided for contact with Canadian transit bus manufacturers in order to learn how market research and passenger attitudes were incorporated into bus interior design.

Three manufacturers, New Flyer Industries, Ontario Bus Inc., and MCI/Greyhound were invited to attend Focus Group sessions. Two firms did so. In addition, meetings and phone calls were made to each of the manufacturers to collect the needed information.

Transit bus manufacturers in Canada do not conduct behavioural research. The needs of riders are handled in an intuitive fashion by design engineers. The designers do have access to some human-form engineering data which can be manipulated through CAD programs. In this sense, Human-Factors effectiveness can be studied. However, such studies are limited to the most basic and definable aspects of space utilization and anthropometry and the information is manipulated by persons without specific training in Human-Factors.

Bus manufacturers report that the current procurement process provides little scope for creativity — their “hands are tied,” was a frequent allusion. Those within transit properties who undertake procurement exercise extensive control over the interior features.

Except in cases of strong corporate impulse to creativity, manufacturers feel it is unwise to deviate from prescribed paths. However, when innovative vehicles are developed — New Flyer’s low floor bus or OBI’s Orion II para-bus — then, of necessity, creativity bubbles forth.

b) DISCUSSIONS WITH PROPERTIES

Corroborating the views of manufacturers, many of the transit properties like to “set the agenda” themselves for procurement. One large property, for example, has procurement centred in the

Engineering Department. Whenever a purchasing action is underway, widespread consultation takes place. Besides Operations or the staff of the transportation division, the engineers responsible for the order will solicit the reactions of marketing, maintenance, materiel, and legal staff who are circulated the full set of procurement documents.

Except for the occasional behavioural study done on subway cars and for the CLRV (the UTDC streetcar), studies of vehicle design tend to be attitudinal and verbal, although some have been conducted *in situ* on vehicles in service.

Greater depth of study has been recently given to the driver's workstation layout which necessarily impacts on adjacent passenger areas.

2. PUBLISHED REPORTS

CUTA conducted a literature search which identified a number of relevant documents. These were supplied for use in the design of the present project. These studies are listed in Appendix A.

3. PERCEPTIONS OF CITY BUS TRAVEL (THE TACL)

By means of the *Transportation Adjective Checklist* [© Behavioural Team], it was possible to learn what perceptions customers hold of bus transit travel.

Respondents ticked an average of 20 words (out of a total list of 181 words). This is a frequency typical of TACL results with other groups. Any individual word has odds of only one chance in 9 of being chosen (20 words out of 181). Therefore, any degree of agreement over 20% should be considered legitimate because it exceeds the usual criteria for statistical significance.

Because Frequent and Special groups are similar in their good familiarity with transit, their perceptions have been added together to yield a larger, more reliable statistical base.

What words do Frequent and Special, i.e. the familiar travelers use?

favourable words

acceptable	51%
needed	49%
accessible	46%

unfavourable words

essential	42%		
convenient	41%		
		crowded	41%
beneficial	37%		
available	37%		
		long waits	36%
		over-crowded	34%
clean	33%		
adequate	32%		
		cramped	32%
		working-class	30%
dependable	30%		

These choices of images represent a wholesome and positive reaction to city bus travel. City buses are acceptable, needed, accessible, essential, convenient, beneficial, and available.

As far as interior design is concerned, a number of the terms relate to design aspects, for example, crowded, over-crowded, clean, cramped, and working-class.

What words do Infrequent travelers use?

favourable words

unfavourable words

		congested	54%
		annoying	50%
needed	50%		
acceptable	50%		
convenient	46%		
		noisy	42%
		crowded	42%
		irregular	38%
		plain	38%
essential	38%		
		expensive	33%
		pollutant	33%
		slow	33%
		stuffy	33%
important	33%		
clean	33%		

These choices of images represent a far less wholesome and positive reaction to city bus travel and introduce some unsatisfactory images. Buses are congested, annoying, noisy, and crowded but needed acceptable, and convenient.

A large number of the terms relate to design aspects... congested, annoying, noisy, crowded, irregular, plain, expensive, pollutant, stuffy, and clean. The term “expensive” should be understood as *relative* to the perception of benefits which the customer receives from transit, not *absolutely* expensive compared to neckties or houses.

It is instructive to examine which words seem to *differ the most* between the two groups. First, the words which are used more by the more familiar riders as compared to the Infrequent riders: shown are words which differ by more than 15%, a figure arbitrarily selected as a useful value.

favourable words

accessible	-17%
dependable	-17%
available	-16%
regular	-16%

unfavourable words

Likewise, the words chosen more by Infrequent riders are...

favourable words

unfavourable words

annoying	34%
congested	32%
irregular	26%
plain	21%
ordinary	21%
expensive	20%
pollutant	20%
slow	20%
close	20%
stuffy	17%
dull	16%

It is no surprise that all the words chosen by Infrequent riders are more frequently negative ones. What is of great interest, however, is that *most of the images more strongly experienced among the Infrequent users are related to design aspects* and so they can be addressed by design and procurement staff.

At the end of the TACL, respondents were asked if they could think of any other words to describe city buses. Appendix D lists the words

nominated. While no simple pattern emerges from these suggestions, there is an over all sense of hostility and negativity. The psychological principles underlying the construction of the TACL required that it be evenly balanced between a population of images which are positive and which are negative. Apparently, many respondents wish to express additional critical thoughts; this wish remains unfulfilled due the neutrality inherent in the TACL.

III ISSUES FOR BUS INTERIOR DESIGN

A. WORDS OF CAUTION...

Members of the riding public should always be considered the incontrovertible experts on their own perceptions. But when it comes to notions of what would represent a *better* state of affairs, the views expressed in a Focus Group research setting should not be taken in a literal sense. Suggestions which people make for the future *can* be taken to indicate their general approach or as a metaphor of their preference.

Readers of this report are cautioned against taking suggestions from study respondents verbatim. For example, to ameliorate boarding problems various suggestions were offered. From the perspective of an experienced transit specialist, *as specific design concepts*, these may not make good sense.

Likewise, respondents are better at recalling the past than anticipating the future. For example, past experience with mobile air conditioning may be unfavourable for some riders. Whether one believes the near future will or will not be a dramatic break with the past is entirely a matter of attitude — whether it is attitudes on the part of members of the public or on the part of engineers!

Focus Groups represent a very good method of exploring concepts and helping target the issues requiring follow-up study. But Focus Groups have limitations. Some of these are shared by other research technologies. In particular, sampling always imposes limitation, using volunteers (rather than forced conscripts) introduces bias, and the need to cover topics “once over lightly” means that depth may be sacrificed.

In the peaceful comfort of a Focus Group suite, it may be difficult to set one’s mind back to a steamy summers’ day bus trip or a frigid wait at the bus stop. In so far as participants can do these feats of imagination well, results are trustworthy.

Some readers of this report may wish to learn about differences among cities, ages, or genders. The design of this study with three types of riders hop-scotched across six cities does not lend itself to such breakdowns.

But by way of summary, it would be difficult to be confident that any apparent difference between cities or regions was trustworthy. Likewise,

Toronto and Montreal riders are not reliably distinguishable... except by language.

Where trustworthy differences have been found, they are noted in this report.

B. [PICTORIAL OF CHAPTER CONTENTS]

C. BOARDING

At the conclusion of the evening's discussions, the mini-survey asked respondents to describe three improvements they would like to see. The single most commonly identified group of design elements which customers wished to see addressed were aspects of boarding. 50% of respondents mentioned this category.

1. FROM THE STREET INTO THE BUS

Why is boarding a problem? The reason is that conventional buses are designed for too great a change in height within too narrow a staircase. The height isn't inherently problematic for a public setting, wheelchair users aside. More specifically, our existing bus configuration requires passengers to ascend to floor height in one-third the width of the bus. And that is because we expect passengers to pass near to a fare box which is surveilled by a driver. Easing any of these assumptions leads to a much better stairs.

The topic of boarding resulted in an active discussion. Remarks were channeled into *first step* and *later steps*.

The first step was singled out for criticism. Except when the bus was close to a curb of normal height, the first step was deemed an obstacle by persons beyond youthful age. The latter steps may or may not have been as much of an obstacle, depending on their riser height. For example a male from the Winnipeg Special riders said, "...the handrail is in a certain position that you can reach for... it's on the door...you have to look for it. I think as long as everything is in the same place in every bus you get on.... My preferred place is on the right side...."

The mini-survey had a rating scale for "no big steps to climb up when entering the bus." This question (and the similar item relating to leaving the bus) both received ratings of 4.4 (fairly important) and were among the highest priority features. Women gave higher ratings than men both for stairs on entry and for stairs on alighting.

Some suggestions were...

- smaller risers,
- optimized step profile,
- improved handrails which reach outside bus, are available on both sides of entrance, are surfaced with a slip resistant coating in a bright colour, are continuous or, at least, which are accessible at all locations progressively upon entry,
 - accommodation for children such as separate handrail height,
 - medial stanchion or handrail, and
 - wider doors (for carrying parcels) and also narrower doors (with grab rails)

Although not covered in the Study Guide and spoken discussion, it is appropriate to mention another aspect of boarding at this point in the report. An item on the survey asked about “big route signs in front of bus.” This was the most highly rated feature with a score of 4.6 (very important) and was a marginally higher rating than riders’ desires to be able to hear the driver’s announcements anywhere in the bus... also a “rider information” feature.

2. HANDLING CHILDREN AND PARCELS

Children

Boarding with ambulatory children — if they are your own — causes few problems except for the height of places to grasp. However, boarding with a child in a baby buggy is difficult and benefits from the assistance of a second party (or *third* party, if you wish to count the infant). Boarding with children or with infants in buggies is further exacerbated when riders are accumulating at the front of the bus.

Thus interior design must accommodate the buggy, the two adults engaged in lifting the buggy into the vehicle, and the need of drivers to sometimes leave their seat in order to assist.

Associated with these design issues are two information issues. First, not unlike a number of other aspects of transit use, riders don’t know “the rules.” For example, can a full sized carriage be admitted? Or, must an umbrella buggy be folded and stowed? Second, passengers need to learn the skills of being a good rider: what is the best baby buggy to use? What design leaves the driver least in risk of back injury? What design is safest for the child in a bus? Would a Snugly (a back or chest carrier) be better on a bus?

Parcels

Depending on your viewpoint, either carrying parcels or paying the fare can be a problem when the two must be done simultaneously! Doing *both* is challenging to many riders and especially to individuals with children or with impairments of arms or hands or whose upright stability is poor. Moreover, the floor near the entrance to a bus can be wet or otherwise inhospitable to parcels.

Several groups identified the need for temporary parcel relief near the entrance.

Several groups endorsed parcel bins in proximity to the fare box. Several groups mentioned the value of overhead racks. However, groups recognized the potential problems of lost items and theft.

A male from the Ottawa Frequent rider's group said, "Maybe a small space where baby strollers are pushed up or folded up together or you can put down suit cases ... this much room ... a small area ... it would help."

3. THE OPERATOR AND ADJACENT AREAS

Groups were pressed for their reactions to the driver's workstation. Did it set him or her too much apart from customers? Did the set up appear to present an obstacle to helping passengers when it was necessary to leave the workstation? Was the height of the driver's eyes satisfactory?

Groups were satisfied with arrangements as they now stand and in the respects raised in the preceding paragraph.

Less satisfactory was the barrier *behind* the driver. On the one hand, it was widely recognized that (1) freedom from windshield reflections was important as was (2) the additional security which it might afford from attacks from the rear.

However, many riders would prefer open access to forward vision so as to help their route orientation. Orientation is discussed at length below.

Another areas of concern was called "the nine point turn" by one perceptive participant. By this is meant the controlled neck of passage near the fare box. Some systems place great importance on limiting fare evasion and therefore, these systems procure buses which establish a quite narrow neck of passage so that the driver can surveil riders paying their fares as they pass by one by one.

One comment from a woman in the Winnipeg Special group was, "I had a shopping bag on this arm; I had my purse and another shopping bag on this arm and I held out my fare to the bus driver and he refused to take the money off of me...so I had to put my parcel down and in the meantime everyone is waiting for me...."

As with many design features, compromises must be made. With a narrow neck (intended to reduce fare evasion) comes losses to boarding efficiency, baby buggy ease of use, introduction of additional barriers and controls and, perhaps not least in significance, a psychological message inculcating intimations of mistrust between customers and their transit system.

When asked if the driver has any difficulty getting out of his workstation a male from the Brampton Frequent rider session said, "No, he just flips his belt and off he goes out." A male from the Toronto Special group said when asked if it is easy to speak to the driver "...only if you are coming on. ...coming from behind the driver, you have to duck around, there are usually two or three people standing there...."

To answer questions about the nine point turn, mock up studies would be very helpful.

As a result of documented health concerns, there is a growing trend today to install well designed, elegant looking "thrones" for the drivers. In an effort to explore possible rider animosity to this apparent luxury, groups were asked to rate the importance of "a posh set up for the driver which is comfortable for him or her for the entire workday." It was deemed advisable in constructing the scale to set the question in a positively skewed direction — "posh" — in order to foster criticism.

Rather than animosity, a great deal of support for "posh set ups" was found. Ratings averaged 4.0 (fairly important). While in the middle range of approval, it rated higher than air conditioning and even the desire to have commodious seats for passengers!

D. ON THE BUS

1. WALKING AND STANDING

The third most commonly identified group of design elements (as written in on the mini-survey) which customers wished to see changed related to standing. These were indicated on 34% of the questionnaires.

On the question "What is the worst thing about...," standing was in third place. 12% of respondents mentioned it.

a) STABILITY AND SAFETY

Maintaining balance and personal decorum while walking or standing in a moving bus was discussed at length in all groups. This is indicated by the widespread concern expressed about the hazards of moving from the driver's area past the wheel well area.

The passage of this distance often mates in time with the acceleration of the bus away from the stop at which the rider boarded. The wheel well area, in almost all buses, is an area with few stanchions. Often only overhead grab rails are present which are useless for many riders. Finally, the rider may not yet have his or her "sea legs" adjusted to the motion of the vehicle. A comment

from a female Infrequent Ottawa user said, "...if you have a pole that goes from the top of the bus to the floor you can put your hand wherever you need to and you stay stable."

Broadly speaking, there are three families of handholds:

- stanchions... which can be floor to ceiling or be attached to the tops of seat backs; they were widely approved, and represent a highly recommended solution from the Human-Factors literature,
- overhead rails... are liked by few riders and disliked by many short riders and especially frequently by women; that is because the concept violates Human-Factors principles in that there exists no design height which is low enough to accommodate many people without being hazardous to many tall people,
- rails on backs of seats... are frequently used but under crowded conditions they are hard to reach and sometimes the clothing or hair of the person seated there will be snared.

Several groups mentioned "straps," a generic term for *some sort of* object suitable for grasping which is suspended from the ceiling or from an overhead rail. Riders in many groups were enthusiastic about introducing a strap which was flexible, low enough for short riders, soft enough not to be hazardous to tall people, numerous enough for crowds, and solid enough to offer the support needed.

Montreal bus riders use flexible straps. The Montreal participants liked them.

However, the Human-Factors literature frowns on such an approach, considering the concept of *flexible safety grips* as something of an oxymoron. Never the less, straps do seem to help in subways, although the motions of a subway car are far more regular and predictable, and they are of lower amplitude than on a bus.

Straps can be constructed with only a single degree of sway. Spring retracted, rigid metal fixtures which rotate on a ceiling mount appear to be effective.

b) CROWDING AND MOVEMENT

Crowding is taken as a fact of life among riders. Special riders, often retired people, recognized that it was in their power to travel at off peak times. A woman from the Vancouver Frequent group said, "I think if the first half of the bus had a wider aisle, that would encourage more people to go to the back of the bus."

Crowding leads to several problems. When crowded, it may be difficult to reach handrails on the backs of seats. Moving towards the rear for purposes of leaving by the rear door or to allow more room for people who are boarding becomes hard.

The tone of these Focus Groups was not targeted to elicit depth psychology comments; even so, remarkably few comments damning "other riders" arose. For example, no one complained of undue or unwelcome social contact (except of the verbal sort).

Crowding was by far the highest chosen category of "worst thing about" bus travel. 46% of respondents mentioned crowding. Frequent, Infrequent and Special groups did not appreciably differ in this judgment. (Temperature problems were a weak second place at 21% of respondents.)

2. SITTING

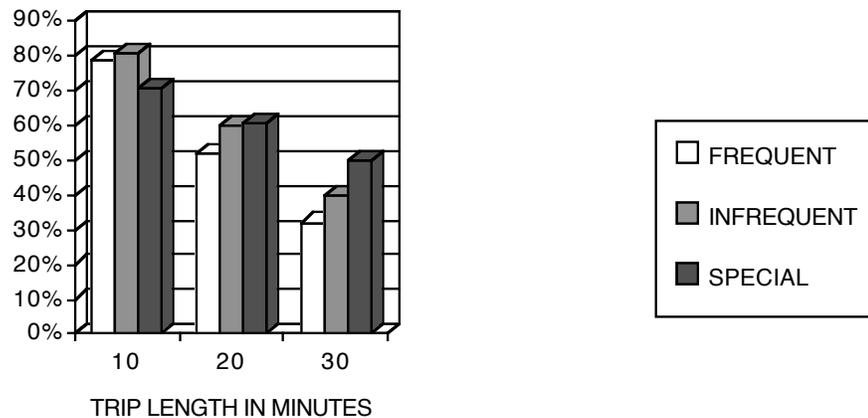
The fourth most commonly identified group of design elements which customers wished to see improved related to seats, 32% of respondents mentioned them.

a) THE IMPORTANCE OF SITTING

On the survey was a series of forced choices regarding the importance of having a seat. For a specified headway (5, 10, or 15 minutes) would the respondent prefer to (1) board a crowded bus and stand or (2) wait for the next bus. The choice is between the certainty of standing versus the possibility of sitting on the next bus... just like the decision we all make in real life.

Results for a 5-minute headway are shown in the chart below.

PERCENT WHO BOARD AND STAND – 5 MIN. HEADWAY



The chart indicates that the great majority of riders favour boarding the first bus when the trip length is 10 minutes even if no seat is available. The odds go down for longer trip lengths.

A curious feature of these data is that the Frequent riders are more inclined to wait for the next bus for any stated trip length. This may indicate that frequent users have greater confidence in the transit system: they believe that the next bus will arrive no later than scheduled and that it will not be jammed with riders.

Riders also indicated their choices for headways of 10 and 15 minutes. Results can be found in Appendix D.

Over all, most passengers say they would rather board than wait for most of the pairs of times. This indicates *that for the time choices presented* standing (with the implication of arriving sooner too) is preferred to waiting for a second bus (then sitting but with a longer total trip time). Frequent riders are more inclined to bide their time and await a second bus as compared to infrequent riders. Special riders, largely elderly customers, also tend towards patience.

Viewed from the perspective of the transit planner, if more passengers would opt for waiting rather than jamming into the first bus, then...

- bus loads would be smoothed out,
- the forces which lead to convoying would diminish, and

- exponential crowding, with harm to driver's and customer's attitudes, would be reduced.

Other aspects permitting, sitting is more comfortable than standing, But *how important* is the opportunity to sit and to sit comfortably?

The rating given for "always have a seat (a comfortable or an uncomfortable seat)" was 3.8 (fairly important). It was deemed almost as important to "always have a comfortable seat." 3.5. This relationship was similar across groups and genders. Among all the features rated, seats and sitting appear among the lowest rated.

On the other hand, one can picture different responses to this question if it were asked about long-haul coaches with upholstered seats. In such instances, it might make a great difference to the customer to be seated when comfortable seats might have been available.

Riders are not hypersensitive to the inevitable jostling and body contact *when seated* which is part of rush hour travel. "Not forced to rub against other passengers when seated" did not appreciably differ among groups or genders. Ratings were in the intermediate block among design features, averaging 3.9 (fairly important).

b) SEATING CONFIGURATION

Opinion was mixed on whether it is better to sit facing forward or toward the aisle. The great majority favoured forward facing seats. But some individuals liked the bench seats because of the increased leg room and space to spread out. A woman from the Vancouver Frequent riders group said, "...you know where you first get on... there are three or four people [who] can sit there. Why not take that last one out and spread out the other seats."

When the slippery fiberglass seats were present, the bench seats were strongly disliked because they do not have enough friction to adequately impede sliding about and so the rider is jostled back and forth. Transverse fiberglass seats were also criticized for their slipperiness which permits sliding about laterally.

When baby buggies or large parcels are being transported, the front bench seats are sought for convenience and room. One woman from the Winnipeg Frequent group said, "When I have my kids with me, I like to sit at the front. We sit on the long seats or the first short one."

c) UPHOLSTERY

A great deal of discussion was paid to upholstery or the finish of seats. Universally, riders prefer “the old seats” which were undemarcated, vinyl covered, and spring upholstered. Of course, there was no other way to design cushioned seats, in “the old days.”

It is taken for granted — perhaps as an unexamined assumption — that such seats are out of the question today due to the cost of maintaining such eminently vandalizable seats. Whether there exists a preferred seat which retains some of “the old seat” comfort is an open question. One male from the Toronto Infrequent group said, “They have those individually padded seats... red pads...seat dividers... it’s good to have because ‘this is your seat.’”

As for current seats, there is a considerable range of seats being used. Seats covered with a coarse fabric, under layered with a resilient pad seems tolerable.

Fiberglass seats were widely disliked, as mentioned above.

The issues brought up about seat design are the following...

- the single greatest attribute which respondents assign to upholstery is the ability to limit sliding about on the seats,
- the pitch of seats, or knee room, is unacceptable to too many customers, perhaps even a majority of riders,
- the mounting of seats seems in some instances to be poor, sometimes feeling tilted forward, sometimes too high (with resulting pressure behind the knees of short riders), and sometimes too close to the wall.
- seat coverings which dissipate wetness or which, at least, can be eyeballed as wet, are desirable, and
- opinion is divided on whether demarcation of seats is worthwhile; the considerations include...
 - demarcated seats may be too small for many riders,
 - they don’t lend themselves to reapportionment as when a large and a small person share a two person seat,
 - they define a “personal space” but at times the rider may need to “capture” a larger personal space or a space and one half.

Despite pressure from session moderators, respondents had trouble coming to grips with the issue of 2+2 or 2+1 seating. Vancouver Frequent riders, for example, felt that their longish trips — perhaps 40 minutes — would be more satisfactory with 2+2 seating which enhances the probability of getting a seat. Over all, most groups preferred trading away seats for more numerous standing places. The Moderator suggested that “more numerous” means two standees accommodated for each seat removed. Some Toronto Frequent travelers joked about taking *all* the seats out!

In summary, transit seats remain a problem area. Given the number of customer’s backsides and knees which are daily in contact with these seats, a re-thinking seems essential.

3. BODILY COMFORT

a) CLIMATE CONTROL

At the conclusion of the evening’s discussions, the second most commonly identified group of design elements which customers wished to see changed were aspects of temperature and ventilation control. 47% of respondents mentioned this area, just below the number mentioning boarding improvements (50%).

Likewise, about 26% of Frequent and Infrequent riders wrote in that temperature was the worst aspect of bus travel, the second most frequent mention after crowding. However, Special riders were far less bothered by temperature problems; only one Special rider mentioned it, 3%.

(1) AIR CONDITIONING

Many participants were unfavourable to *the prospect of* air conditioning on urban routes. These sentiments were based on the following perceptions...

- frequent broken systems,
- poorly set temperatures which are often ferociously cool and which strongly contrast to the street when alighting, and
- unwillingness to settle for no ventilation back-up in A/C failure.

Some respondents welcome air conditioning. Air conditioning works just fine in a great many transportation settings, they felt, and would be a good feature, considered just on its own bodily

comfort merits. One male from the Brampton Infrequent session said, "In Brampton, the air conditioning works great."

In group discussions, it was apparent that two currents of social thought were present. First, ecological considerations *are being raised* and transit, in the forefront of ecological thinking, should encourage this. Within each group were speakers who knew the costs of freon to the atmosphere and the costs of the energy of cooling a bus. Second, riders everywhere are very conscious of the relationship of features and costs... *at least as they perceive the relationship.*

While superior mechanical ventilation is not inexpensive, a reasonable behavioural hypothesis is that air conditioning (but not sophisticated mechanical ventilation) would be perceived as squanderous to customers.

Do results for the anonymous mini-survey rating confirm the spoken of public data? Air conditioning ("air conditioned in the summer") rated 3.3 (neither important nor unimportant). While this does not represent strong disapproval of air conditioning, it is the single lowest rating among the 11 features presented.

Men seemed a bit more inclined to favour air conditioning with a rating in the frequent group of 3.4 versus 2.5 for women. This was the largest of the few gender differences found in this project.

From the Human-Factors point of view, there may be no satisfactory air conditioning design *for city buses*. A temperature which is comfortable for long term sitting, may seem hardly cool enough upon first boarding. A temperature cool enough to bridge the onslaught of hot air during the period of open doors, may be far too cold for a healthful feeling when the rider returns to the warm street.

Further, the Human-Factors and Mechanical Engineering effort needed to devise and implement windows which offer decent ventilation when the air conditioning is broken or during shoulder seasons is a formidable task. In principle, the same effort would be needed to devise an air conditioning back-up as would be needed to devise a good fresh-air system of ventilation.

In conclusion, the desirability of A/C hangs on a great many assumptions and perceptions. If effective, inexpensive, and environmentally friendly air conditioning could be devised (with a benign failure mode), it might prove a very welcome improvement to city bus design provided that adequate

information was distributed to customers which addressed their concerns.

(2) HEATING

Buses are widely considered over-heated in the winter and extra heat is experienced around the back bench seat. Respondents are not sure why this is so and if this is inherent in bus design. Some riders hold definite opinions on this subject.

- Some believe that the driver sets the temperature to suit himself or herself and they wish to have it hot because they work in shirtsleeves.
- Some believe that drivers ought to have the right to set the temperature, after all it is *their* workplace.
- Some believe that there is no good adjustment possible due to the complexities of bus operations and some of these people believe that the thermostat is set at the garage and is not locally adjustable.

Over-heating in the winter is a source of discontent among riders. Additional frustration arises from the perception that the controls affect both the riders and the driver. A male Frequent Toronto rider said, "...people tend to wear heavy coats because it's in the winter...you might as well not have heat on or minimal...or why would they not have a temperature control?"

This was an area of major concern that reinforces the need to review the climatic control system and behavioural management policies on buses.

(3) VENTILATION

An overwhelming number of people favoured greatly improved ventilation. Existing arrangements of windows and forced air were deemed seriously deficient.

Few comments were made as to the specifics of forced ventilation. Some riders recollected that heat is blown from a duct at shoulder height when they are seated alongside the window.

Riders do not believe that there is mechanical ventilation in buses, unlike the familiar fan, heater, and defroster found in cars.

Improved ventilation is sought for bodily comfort in all seasons. It is also important to demist windows.

(a) WINDOWS AND VENTILATION

Windows are a source of aggravation to riders. As with seats, retail customers welcome a better level of attention to their needs. Riders are, as is often the case, highly accepting of the needs of the property, as they understand them. Thus riders, in Winnipeg especially, felt that it was important to prevent the loss of arms and the pursuit of mischief which open windows can bring about.

Some window problems mentioned frequently are...

- they don't work as designed,
- they sometimes rattle and are noisy,
- as designed, they aren't suitable for people of modest strength,
 - the design is not liked — such as windows which only have a small opening at the top of the window, and
 - they require large-scale social consensus because they affect people for many rows back.

Riders want windows which affect only the single person who is near to the window. They should be easy to use, admit air but not rain, and the strength of the breeze should be adjustable by the user. In Vancouver, a damp place, fog on windows and the effectiveness of de-misting were discussed.

In summary, the conditions sought by transit riders are the same as those which Human-Factors specialists ensure to space travelers and arctic parties: self choice. The ideal is simply the design found on the PCC: one operable window with a modest opening per row of seats... and they shouldn't rattle.

(b) ROOF VENTS

Respondents generally like roof vents. Only a few riders felt that they were permitted to touch the vents although the

manufacturer believes customers ought to control the vents themselves. Many riders were unsure if they should or should not touch the roof vents.

The utility of an open vent depends on the weather and on bus operations. It would not be good work design to burden drivers with the responsibility to keep track of the roof vents, opening them when it is hot and closing them during fast drives, etc. Therefore, it would be beneficial if customers were encouraged to control roof vents and if they were clear about their prerogatives, *the uncertainty itself* is an additional source of concern.

b) NOISE

(1) WINDOWS

Members of several groups were disturbed by window rattles. Traditionally, one psychological benefit of transit is freedom from distraction which — unlike driving a car — allows the rider to read, work, or daydream comfortably. Disturbance arising from noise is therefore not desirable.

(2) ENGINE NOISE

Noise from the engine was deemed excessively loud only when the rider sat at the extreme rear of the bus. Elsewhere, it was not an important problem.

4. MUSIC, LIGHTING, AND ADVERTISING

Background Music

Some riders would like background music on buses. More riders, however, were emotionally distraught at the prospect of Musak or “elevator music” on buses. These groups cannot be considered an unbiased sample on this issue.

Lighting

The topic of lighting did not generate much discussion. Whatever discussion took place, it was reasonably accepting of current practice

although some riders hoped that light levels would always be high enough for ease of reading.

Are lights which are set very dim — to reduce windshield glare for the driver — a problem? The limited discussions which took place on this topic reflected riders' sophistication: they felt they understood why lights were dimmed and they were gracious in accepting this condition.

Advertising

Advertising was not a source of fertile discussion. What discussion took place showed that it is not objectionable. However, some riders wanted fresh copy to read!

Does the impingement of car cards on potential window space create annoyance? Are riders more vertiginous on buses because some portion of the potential window space is lost? No firm convictions were aired. A female from the Brampton Frequent riders group suggested if the windows were larger "...you would put them [advertisements] on the ceiling."

E. ALIGHTING

1. STRATEGIES FOR KNOWING WHERE YOU ARE

Many riders spoke about problems in knowing where they were along the route. Quite interesting discussions and creative imaginings took place.

At present, there is little to assist passengers who are unsure of the neighbourhood in knowing where they are... except, of course, for the driver. Groups were able to imagine LED signs, perhaps connected to Smart Card readers which announced, "Mr. Jones, here is your stop, Burwash Penitentiary."

Naturally, several sets of signs should be distributed around the bus so people could see the message when the bus was full. One woman from the Vancouver Special user group said, "...[if the driver] could just name the stops don't have it up [in a sign] there because not everybody can read."

Excesses of creativity aside, many respondents would strongly welcome design help with orientation. The technical requirements range from creating a wall space in which printed route maps could be mounted to devising AVM, LORAN or satellite location systems.

Travelers in Brampton (pop. 193,000) highlighted a number of problems which are especially prevalent in suburban areas and particularly in newer neighbourhoods. Infrequent riders (and what Transportation Psychologists call “local strangers”) have trouble knowing where they are because:

- houses and even neighbourhoods look alike,
- few major pathfinding, trailblazing landmarks are present,
- drivers may use privacy screens behind their seats which block part of forward view,
- windows are sometimes dirty especially in winter,
- bus shelters are not common and they are not marked with a location sign which can be easily read from a fast moving bus, and
- at night, streets have few street lights.

and, like other places...

- the tops of bus side windows may not be high enough,
- the tops of bus windshields may not be high enough,
- there may be no rear window, and
- other passengers may be blocking view forward or to the sides.

An aspect of orientation is the ability to see the street (“good view to the outside”). A rating of 4.4 (fairly important) was given. This rating is the third highest although tied in importance with steps and door width ratings.

Doubt as to where you are is a source of anxiety for new riders as well as a discouragement to experienced riders who are “local strangers” to an unfamiliar part of town. The absence of rear windows in some new bus models further impairs orientation confidence.

Low floor buses mean lower eye height when sitting or when standing. When sitting (and to a lesser extent when standing) the ability to see where you are on the route is reduced. This is identified as a problem on existing buses by tall riders while standing.

2. PROVIDING ROUTINE INFORMATION

While designs which support good driver service are desirable, designs or technologies which (1) reduce the need for services from drivers or which (2) introduce new services which do not engage the

driver are more desirable. For example, it would be nice to have a clock on the bus, some riders thought.

Reliable announcement of stops was strongly advocated by participants. While, on average, drivers do an acceptable job of announcing stops and a praiseworthy job of announcing stops when specifically requested to do so, the sample were intrigued by the prospects of new technologies.

Groups imagined various forms of stop announcement technology. Among the aspects which were advocated were...

- automated, changeable message electronic signs,
- electronic annunciators distributed around the bus so as to reduce the need to crowd around the doors, and
- basic route maps with community features present.

Mediating active help from the driver is the ability to hear the driver's announcements. Respondents rated at 4.5 (very important) "easy to hear announcements from the driver anywhere in the bus." This rating makes good announcements the second most important feature (marginally less than desire for big route signs).

This is an important area for further R & D effort.

3. **"CAN THE OPERATOR SEE ME AT THE REAR DOOR?"**

A widespread concern was problems of egress, discussed below. This concern was heightened by uncertainty about the driver's ability to see the deboarding passenger while he or she stood at the back door. One woman from the Frequent Winnipeg group said, "I think they should have a conductor in the back... he'd have his own special seat the same as the bus driver."

This problem is made worse by the further uncertainty over the door control logic circuitry. Can the bus depart while the door is open? Can the driver ignore or be unaware of a stop request? Does the treadle or swing door pre-empt bus operations?

From the psychological perspective, the mechanisms of door actuation need further development. Good design means that the "operator" (meaning the customer, in this instance) receives feedback signals to confirm or disconfirm the state of the system the person is trying to control. Therefore, the introduction of stop request acknowledgement signs was an important step in the right direction.

The consequence of problems working with the driver upon alighting is that riders bunch about the front door with consequent harm to operations.

4. FROM THE BUS TO THE STREET

Perhaps the most serious issue relates to the paradox that door actuation mechanisms are inside the bus, but the danger of objects, children, or limbs being caught in the doors arises when the rider is outside the vehicle.

The criticism of the rear doors was as strong as for the front doors and quite similar in nature. The steps (and especially the bottom step), the presence and location of hand holds, and issues of width were raised. In addition, the problem of buses not being close to the sidewalk and being stopped adjacent to uninviting footfalls (snowbanks or worse!) was encountered only for rear exiting.

The problems of struggling with parcels and with children when alighting were mentioned in several groups. For example, a woman from a Toronto Frequent user's group said, "... but the back doors are even worse than the front doors. One time I tried to get off the bus and you can't get the stroller on to — you know the step — and you step on it and the doors open. Well you put the stroller on it and it does not open the doors and then what do you do"

When asked to rate the importance of "extra wide rear doors," respondents placed is at 4.3 (fairly important). While marginally lower than the rating given to eliminating big steps, it is in the same range of importance.

As previously mentioned in connection with boarding features, the mini-survey had a rating scale for "no big steps to climb down when leaving the bus." This question (and the similar item relating to entering the bus) received ratings of 4.4 (fairly important) and were among the most highly rated features.

IV CONCLUSIONS AND RECOMMENDATIONS

A. ASSESSING CUSTOMER PERSPECTIVES

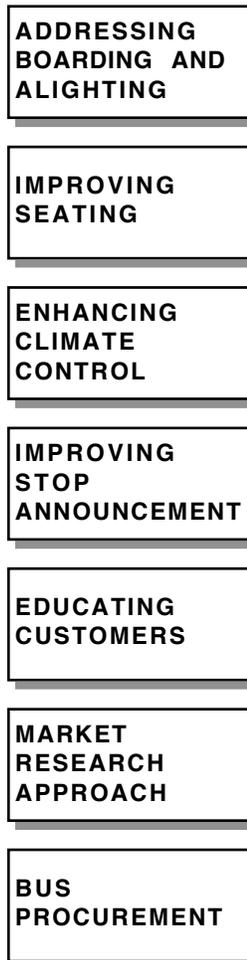
This research examines details of urban bus design. But are there any general patterns of thought or feeling which characterize this sample?

Some trends are as follows.

- Frequent travelers are quite sophisticated in many ways. For example, they can rattle off all the routes (route names and numbers) which converge on a certain corner and reflect their knowledge in many ways. On average, riders readily sense that upholstered seats are subject to damage from vandals and are quick in drawing other inferences about transit.
- At the same time, riders are not at all sure of certain information which transit properties may take for granted. For example, riders have no idea how well the driver can see them at the rear door, if baby buggies can be left open on a bus, or how the rear doors are controlled.
- Riders are quite alert to aspects of equipment and service which they perceive as influencing the size of their fare. They react to features with fare consequences in mind.
- Riders are alert to increases in fares and, in so far as the present study offers any guidance, prefer a more basic level of functionality over high fares. Naturally, neither riders nor specialists are always sure how to relate a feature or service to a fare. However, it is important to understand the perceptions of riders.
- In 1991, most riders seem quite able to “walk in the shoes” of disabled or frail travelers. But the specific trade-off of social tolerance versus personal trip time which an individual riders makes remains to be defined.
- Attitudes towards transit bus design seem quite uniform across the country and the same tendencies and spreads of opinion are found across this sample.

B. RECOMMENDED RESEARCH AND ACTION

1. [PICTORIAL OF RECOMMENDED RESEARCH AND ACTION]



2. ADDRESSING BOARDING AND ALIGHTING NEEDS

One of the main areas needing attention in future bus design is boarding and alighting. This has several sub-problem areas.

Level change

As long as bus floors are high, passengers must ascend and descend a number of steps. Currently, much effort is going into lowering the height of bus floors. This brings about various other problems, at least in designs tried so far. These are discussed below.

Doors, door control, and entrance area

There was no solid consensus among riders as to the ideal door. Because of the great range of types of doors in service, it was hard to develop any consensus. Designing acceptable doors requires an understanding of problems related to...

- *width* when traveling with children or carrying parcels.
- *support* in the form of places to hold on to and places to momentarily deposit parcels,
- ability to *see through* the door, particularly to the street when deboarding, and
- *sense of safety* in relation to door motions, sensitive edges, interlocks, and hazardous protuberances.

Handholds

Many complaints about handholds were voiced both regarding entrance and exiting. This should not be a problem in as much as the principles of devising good support are quite simple to understand and non-critical to apply. No further research is needed because the literature on stair accidents and handrails is detailed enough... some of it developed by Canadians.

Destination signs

Boarding also means confirmation of the route and contact with the driver. It is clear that the public wish to have more prominent destination signs. In a previous Behavioural Team study it was demonstrated that there is often a low level of comprehension of destination sign information. This results in needless contact with drivers and nuisance to passengers.

Encouraging rear door alighting

Alighting means encouragement to use the rear door for leaving the bus. There are many reasons why people prefer to leave buses from the front (outlined in a paper authored by Behavioural Team dealing specifically with this topic and referenced in Appendix A). Many of these reasons are open to influence by better design. More on-board information (such as next stop announcements, would reduce the need for customers to stand near the driver.

Encouraging more enforcement of no parking (and no stopping) rules at bus stops would also permit drivers to bring the rear door within stepping distance of the curb. It would have a great benefit on the numbers of customers who then feel confident enough to use the back exit

3. IMPROVING SEATING

The groups were critical of current seats. Objections were raised as to many aspects of the seats themselves as well as the direction and pitch of rows and seat size.

It is clear that seats cannot be designed from textbooks. In working on seats for Roy Thomson Hall, home of the Toronto Symphony Orchestra, Behavioural Team recommended that the Building Committee install candidate seats in their boardroom and give them the "test of time" because board meetings were as long as concerts!

Seats can be tested away from buses for most aspects of comfort. Ultimately, a bus will need to be outfitted for a number of sets of contrasting seats and paired-comparison judgments made by (1) representative riders as well as by (2) extremes of the anthropometric scales, say, 95th percentile individuals in height, weight, width at buttocks when seated (and clothed for the winter), knee height, and so on.

4. ENHANCING CLIMATE CONTROL

Temperature and ventilation comfort are matters of great concern to riders. Properties are actively investigating the value of air conditioning, an approach to comfort which represents a major historic commitment on their part.

It was the general preference of the groups to have superior unprocessed air rather than go with air conditioning and all it implies to riders in costs and the expected loss of fresh air through operable windows. It is a challenge therefore to engineers to devise systems which bring about comfort yet which counter the fears which customers hold for fare, reliability, environmental, and other negative impacts.

This may be accomplished through... better air conditioning, mechanical ventilation, making fans noisier so riders can more easily sense that they are working, separating out two thermostats for drivers and passengers, or by new means.

Unfortunately, it is very difficult to study human comfort and the evaluation which must follow the engineering efforts will require subtle psychological conception. Because of the many variables involved, it must be studied by means of professionally designed tests

done in realistic settings. Ideally, a bus or buses should be outfitted with candidate designs and riders tested appropriately.

5. IMPROVING STOP ANNOUNCEMENT AND ROUTE INFORMATION

Knowing where you are on your route was a serious issue for many riders, especially, Infrequent respondents. Animated discussions of automated route maps and computer generated voice messages took place. For example, a Toronto woman from the Frequent user's group said, "personally what I would love to see on a bus would be an electronic sign telling you what stop is where; where you are at and where you are going. and that everybody is able to see it... ."

There are various possibilities...

- mounted route maps,
- familiar local "trail blazer" highlights identified on maps,
- time and other information,
- ergonomic stop request switches,
- easy to use public address systems,
- "take one" route maps,
- LED signs, and
- voice annunciators.

In a curious reversal of tendencies, riders *overestimated* the technical effort of providing such features. With AVM becoming commonplace, automated route maps and stop naming cannot be far from reality.

6. EDUCATING CUSTOMERS

A few years ago, at the request of CUTA, Behavioural Team created a rider "training" video for para-transit users. After all, customers have a lot to do with the efficiency of *their own* service.

Likewise, in this report, there have been several instances where a better rider results in a better level of service. For example, willingness to trust one's luck and await a second, less crowded bus, or knowledge of the best transit-approved baby buggy are important behavioural training goals.

There may be certain perceptions which are not accurate and which hinder transit operations. For example, individuals in each group felt that bus air conditioning would be harmful to the ozone layer.

This fear may be over-stated because, in reality, few air conditioning maintenance settings are more well-controlled than a major bus garage

in which specialist technicians service units they are probably well trained to maintain. Further, newer forms of refrigerant with less damage to the environment are now being used. Whatever the reality in *this* case, there are instances where transit properties wish to influence their riders' opinions to be more favourable to the property. The decision to proceed with air-conditioning on buses should involve an information campaign to address environmental and financial concerns of customers.

When a property moves to an exact fare system, for example, customers must undergo training of the most punishing kind, without instruction, and under distinctly negative circumstances. How can we help riders adapt to such changes successfully?

What other skills do we hope our riders have?

7. MARKET RESEARCH APPROACH

Retail operators of every sort are keen to have a good understanding of their customers' needs. Managers assume that they have a good grasp of customer wishes. This assumption *might* be reasonable when...

- the manager exists in the same economic or cultural milieu as customers,
- he or she can unobtrusively observe conditions or speak with customers in a manner which elicits unbiased and perceptive answers,
- information about existing conditions is a satisfactory preparation for future conditions, and
- the manager has the mental equipment to deal fairly with the information.

Given the dubiousness of *all* these assumptions, wiser managers undertake more objective intelligence gathering, for example, cash receipts or the jingle of the fare box. Such end results tend to be too far down stream in the retail process to offer current or detailed intelligence on strengths and weaknesses. Instead, it is best to put in place systems of ongoing customer debriefing and "pulse taking" designed by professionals.

Once it is known that changes are needed, a property should seek to understand the specifics of their customer's needs. In the first stage, there is a need to understand the general concept of the need or problem. This can be done by verbal methods such as surveys or Focus Groups.

Once a verbal sense of the need is established, it is very important to gather solid Human-Factors design information. This ordinarily requires behavioural records such as mock-up tests rather than relying on textbooks or even past experience.

There are lots of professional ways of studying the needs and wishes of customers. For example...

- observations of use,
- surveys,
- “Mystery Rider” methods,
- Focus Groups,
- Human-Factors handbooks,
- individual ratings,
- simulation games and trade-off activities,
- role playing,
- mock-up testing,
- diaries,
- archival data, and
- movement analysis,

to mention some of the techniques available.

There are not many reliable studies of the needs of transit riders and very few in Canada. Thus more behaviourally-oriented research is needed into customer requirements and the evaluation of designs.

8. BUS PROCUREMENT

...and all these design issues come to roost on the desk of the professional who is responsible for bus procurement within a transit property.

As with many generalist jobs, wouldn't it be nice if the incumbent were a genius who fully mastered the intricacies of automotive engineering, maintenance, human resources, environmental protection, economics, and *psychology*. The question is, now more seriously addressed, what should the procurement specialist take away from this report?

Some aspects of psychology are currently being actively addressed as a result of CUTA's initiatives in driver workstation ergonomics. Currently, the occupational health, safety, and efficiency of drivers are taken into account. The next step is the ergonomics of riders.

The principle lesson might be: it is important to correctly determine the facts of customer needs and to serve these needs as well as the more traditional demands. Transit is a retail business and, “in retail, the customer is king.”

C. RELATED TOPICS NOT FULLY EXPLORED IN THIS PROJECT

1. IMPLICATIONS FOR THE DESIGN OF LOW FLOOR BUSES

a) RAISED SECTIONS

What issues might become salient with low floor buses?

Seats

Some low floor designs raise the seats on a platform. At first thought, this is hazardous and, in a building, it would be contrary to the National Building Code.

Can a design be developed which is not hazardous?

Other raised sections

The rear section of a currently available low floor bus is raised. The increased height is made necessary by the need to have the floor above the drive axles.

Several properties have voiced concerns about the safety of having riders going up steps within the vehicle while the bus is moving.

b) OTHER CHALLENGES

Low floor buses may have intrusive features on the floor such as gas tanks or wheel wells. Can these objects be turned to any advantage for holding parcels or mounting information or advertising?

When a rider looks through the windshield of a low floor bus, he or she cannot see as well as they could in a conventional height bus, nor can the driver. Will it be necessary to enhance the rider's sense of orientation by other means to counter-act this loss?

The treadle to activate the rear door in a low floor bus is not as neatly demarcated as in an ordinary bus — where it is simply the first tread below the floor. This study has shown that riders are uneasy about the door control logic and any design that would further increase this unease would be undesirable. Human-Factors psychologists favour mechanisms which allow the users of devices of any sort to have a correct intuitive grasp of the functional relationship between the riders's act and the door's behaviour. Paradoxically, intelligent electronic systems — when properly conceived — can bring about the illusion of intuitive simplicity. What is the best means of door control from rider's point of view in a low floor bus?

2. FARE PAYMENT

Fare payment issues were consciously deleted from this project because they are too important for the scant time which would have been available for their exploration. Fare payment is an area under active development in the transit community. Some behavioural issues include...

- the numerous impacts of self-service entry,
- the use and impacts of add-fare, credit, or smart cards,
- interfacing the technology needed to address the issues arising from flexible pricing varying with distance, time of travel, and freedom to transfer and to board again (length-of-time pricing), and
- confinement of bulk queues, constriction of linear queues, rate of loading buses, and, in general, designs expressing antipathy towards passengers (versus the costs of increased fare evasion arising from more open designs).

The effective implementation of new fare paying concepts and technologies is contingent upon the development of user interfaces (or "HCI," human-computer interaction). Technologies which are hard to use — which are user unfriendly — will not be popular.

3. SAFETY

The topic of safety was briefly aired in some of the sessions. Riders do not appear to be overly concerned. But this may reflect the general trusting attitudes towards safety noted above.

Paradoxically, it is intellectually perilous to study safety. On the one hand, nothing could matter more to most people than arriving at their stop still alive. On the other hand, surveys rarely elicit rich material on safety concerns because riders routinely assume that transit properties have quite thoroughly investigated all safety issues and have protected the rider from all harm.

While this assumption is more or less accurate, certain decisions are not simple for a transit property to make. For example, there may be a conflict between the important need for ventilation and the danger to safety arising from arms or objects projected out of open windows.

Many issues of safety have been treated coherently in the Human-Factors psychology literature over the years. For example, optimum stair profiles, tolerable acceleration and deceleration values, best diameters for stanchions, anthropometric data for overhead grab rails, and information acquisition and handling have been well analyzed.

Low floor buses may introduce a safety hazard to riders. Impacts from cars to the side of a conventional bus occur below the height of the passenger compartment. But on low floor buses, impacts would not be lower.

Many safety questions can be resolved through the existing psychological literature, augmented by the testing of mock-ups. Whether or not participants in these Focus Groups were alert to safety issues, safety is a matter of great importance and needs to be addressed by more appropriate social research.

4. SECURITY AND SOCIAL BEHAVIOUR

In as much as most thought is given to *anti-social* behaviour, studies of personal security while on board the vehicle as well as in relation to the transit stop can be handled together with other aspects of bus social interaction.

Because of the difficulty which many people have of speaking about *details* of their insecurity, Focus Groups dealing with *equipment* are not an effective research setting. Better would be individual or depth interviews joined with behaviour observations on existing systems.

APPENDICES

A. BIBLIOGRAPHY

B. WHAT ARE FOCUS GROUPS?

C. STUDY MATERIALS

1. STUDY GUIDE

2. SCREEN SURVEY AND SAMPLING PLAN

3. MINI-SURVEY

4. TRANSPORTATION ADJECTIVE CHECKLIST (TACL)

D. NUMERICAL RESULTS

1. MINI-SURVEY RESULTS

2. WORDS NOMINATED TO THE TACL

E. FLEET BREAKDOWN AT FOCUS GROUP CITIES

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B. WHAT ARE FOCUS GROUPS?

C. STUDY MATERIALS

1. STUDY GUIDE

2. SCREENER SURVEY AND SAMPLING PLAN

3. MINI-SURVEY

4. *TRANSPORTATION ADJECTIVE CHECK LIST (TACL)*

D. NUMERICAL RESULTS

1. MINI-SURVEY RESULTS

This appendix presents results for quantitative questions on the mini-survey. All questions are addressed in the text. It should be remembered that the sample is small and the results should not over-imbued with significance.

For better presentation in this text, results are not in the same order as they were printed for respondents. The total number of respondents was 133.

THE FOLLOWING THREE QUESTIONS WERE FILLED-IN BY RESPONDENTS. BELOW ARE SHOWN THE CATEGORIES USED TO CLASSIFY RESPONSES AND THE RAW NUMBER OF RESPONDENTS WHOSE ANSWERS INCLUDED SOME ELEMENT IN THAT CATEGORY.

The best thing about traveling in city buses is...

BOARDING	0%
DOORS	0%
CROWDING	2%
TEMPERATURE	0%
STANDING	0%
SITTING	3%
MISC.	5%
OTHER	0%
SERVICE	5%
OPERATIONS	91%

The worst thing about traveling in city buses is...

BOARDING	7%
DOORS	1%
CROWDING	46%
TEMPERATURE	21%
STANDING	12%
SITTING	7%
MISC.	12%
OTHER	7%
SERVICE	5%
OPERATIONS	31%

What three improvements do you most want to see in the way new city buses are designed?

BOARDING	50%
DOORS	18%
CROWDING	11%
TEMPERATURE	47%
STANDING	34%
SITTING	32%
MISC.	51%
OTHER	0%
SERVICE	4%
OPERATIONS	10%

THE MINI-SURVEY INCLUDED ELEVEN BUS FEATURES TO BE RATED ON A SCALE OF IMPORTANCE. THE SCALE (AND THE NUMBER OF STATISTICAL POINTS FOR EACH CHOICE) WAS AS FOLLOWS:

- very important, 5
- fairly important, 4
- neither important nor unimportant, 3
- fairly unimportant, 2
- very unimportant, 1

	MEAN	STD.
DEVIATION		
big route signs in front of bus	4.6	.8
always have a seat (a comfortable or an uncomfortable seat)	3.8	1
always have a comfortable seat	3.5	
easy to hear announcements from driver anywhere in the bus	4.5	.7
air conditioned in the summer	3.3	1.5
good view to the outside	4.4	
not forced to rub against other		

passengers when seated	3.9	.1
no big steps to climb up when entering bus	4.4	.9
no big steps to climb down when leaving bus	4.4	.9
extra wide rear doors	4.3	.9
a posh set-up for the driver comfortable for him or her for entire workday	4.0	1.0

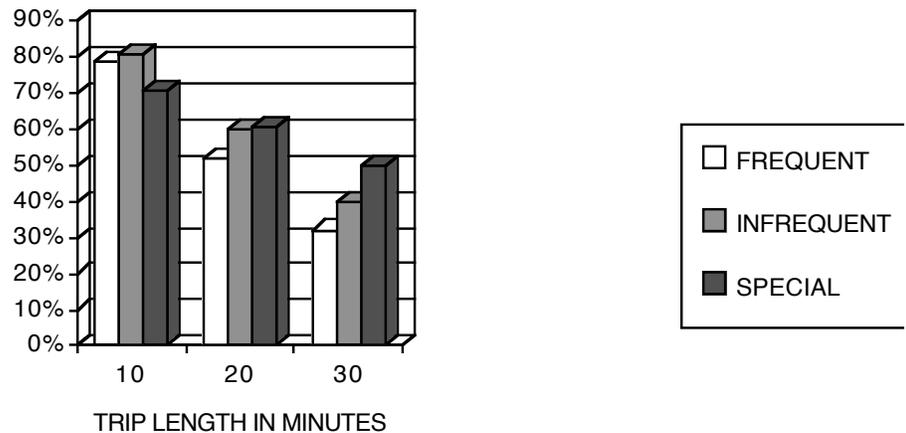
“I would stand on this bus or I would wait for the next bus”

STAND % WAIT %

What if buses were 5 minutes apart and your...

...bus trip took 10 minutes	77%	23%
...bus trip took 20 minutes	56%	44%
...bus trip took 30 minutes	39%	61%

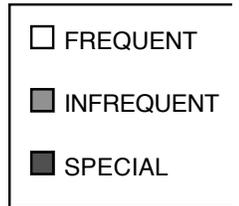
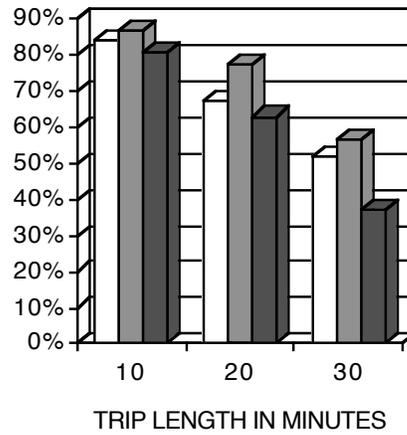
PERCENT WHO BOARD AND STAND – 5 MIN. HEADWAY



What if buses were 10 minutes apart and your...

...bus trip took 10 minutes	84%	16%
...bus trip took 20 minutes	69%	31%
...bus trip took 30 minutes	50%	50%

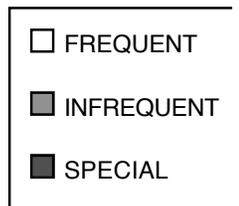
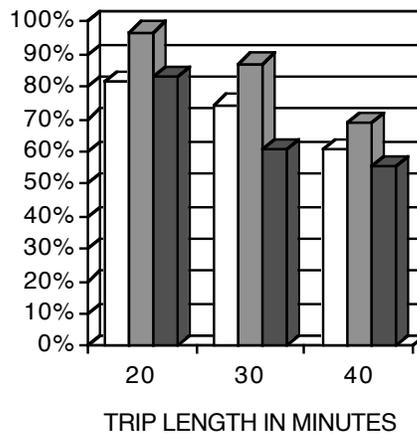
PERCENT WHO BOARD AND STAND — 10 MIN. HEADWAY



What if buses were 15 minutes apart and your...

...bus trip took 20 minutes	86%	14%
...bus trip took 30 minutes	74.5%	25.5%
...bus trip took 40 minutes	61.5%	38.5%

PERCENT WHO BOARD AND STAND — 15 MIN. HEADWAY



, Men, 64
, Women, 65

DEVIATION	MEAN	STD.
Height	170 cm.	10.8
Age 18.6	39.5 yrs.	
Days in average month on buses	14.5 days	11.2

2. WORDS NOMINATED TO THE TACL

The following words were written-in as respondent nominations to the TACL for city buses.

FREQUENT

necessary no alternative
advertised well
it sucks
the bus
(Frequent Toronto)

=====

bus sheds necessary
stink
non-interactive
inconvenient
unorganized
not following schedules
(Frequent Brampton)

=====

occasional
sardine
tight
bearable
gaseous
jerky
dirty
tight
lead foot on break!
(Frequent Toronto)

=====

different
timely
environmentally friendly
unsafe
time consuming
quiet
(Frequent Winnipeg)

=====

high priced
in need of improvement
necessary
well organized
wheel chair accessibility
easy
rude (drivers)
unreliable
improved
well scheduled
(Frequent Vancouver)

=====

inexpensive
too many pillars
more room for strollers
reasonable
effective

basic
injurious
uncomfortable
too hot
too rough a ride
discourious
mismanaged
(Frequent Ottawa)

=====
inaccessible
imponctuel
imprévisible
cahoteux
promiscuité
(Frequent Montreal)
=====

INFREQUENT

monotonous
well-informed
hot-stuffy
difficult
awkward
not-barrier-free
freedom
oversized
communal
unreliable
germ-loaded
hectic
calm
(Infrequent Toronto)

=====
necessary
bad schedules
stops to early
over priced for students
over priced for children
posted schedules
ignorant
(Infrequent Brampton)
=====

insensitive
frustrating
necessary
confusing
bureaucratic
common denominator
non-user friendly
two rated
(Infrequent Ottawa)
=====

alternative
solution à pollution d'automobile

traffic
pas evident
heure de pointe
(Infrequent Montreal)

SPECIAL

on time
considerate drivers
schedules good
necessary
(Special Winnipeg)

excellent
seat belts required
poor exits
uncomfortable
unstressful
economical
pleasurable
poor lighting at stops
unsafe
uncomfortable
politeness
obliging
affordable
(Special Vancouver)

plus avenant
plus souriant
(Special Montreal)

E. FLEET BREAKDOWN AT FOCUS GROUP CITIES