THE REGIONAL SCHOOL BUS SYSTEM AND THE TIME-DISTANCE CONSTRAINT FOR STUDENTS AND HOUSEHOLDS IN QUEBEC'S EASTERN TOWNSHIPS

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Introduction

It has been twenty-five years since the Government of Quebec introduced "Operation 55," a policy that grouped over 1,500 school commissions into sixty-four regionalized school boards (55 Catholic and 9 Protestant Boards). That massive consolidation resulted in school districts serving much larger geographic areas. One of the key constraints identified in the reorganization was the increased distances that had to be travelled to and from school, and the resultant time that was to be spent in a school bus.

Consolidation of schools had been argued on the grounds of efficiency of public services, economies of scale, simplicity in administration, and provision of comprehensive and professional educational programs. This reorganization implied a number of spatial and social changes, such as larger geographic areas under one school board administration, the closure of local schools and the movement of students out of the local community to centralized regional schools. Nowhere was this more pronounced than in the small, scattered, English-speaking communities of Quebec's Eastern Townships.

Over the past twenty-five years, the social, economic and educational values that initiated the centralization of school boards have changed. Public education has become the subject of intense academic scrutiny and public debate. Educational policy has returned to the localized, school-community concept. Education has abandoned its enthusiasm for offering a wide range of academic options in favour of a "back to basics" approach. Demographic profiles display significant reductions in secondary

school attendance, so that some regional schools built for 3,000 students now hold less than a thousand students.

Transportation of students has become a costly and socially questionable activity. Each day 664,030 Quebec elementary and secondary students ride a bus to school. The annual cost for student transportation is $347 million (Ministry of Transport, 1989). Wages, fuel costs and maintenance have caused school boards to question the overall benefits of a regional school system, whereas parents and students have questioned the effects of riding in a school bus for as long as six hours per day.

Statement of the Research Problem

For students and their families living within the English-language regional school system of Quebec, travel to and from school has become a "fixed" daily activity around which households must operate a complex system of time allocations, activities and behaviours. The focus of this research is the problem of time, distance and accessibility to regional secondary schools, and how each factor affects the perceptions and behaviours of individual households.

To date, there has not been any specific research on the impacts of school board reorganization and the time-distance factor upon individual students and their families. Many school boards operate within massive geographic areas, several over 10,000 square kilometres. In some of these school boards, secondary students must leave home and board in communities closer to their schools, while others travel across different time zones, provincial or international borders in their journey to school. The majority of these students, those who spend two to six hours on a school bus per day, have been neglected in the overall assessment of the impact of large, regional secondary schools. Figure 1 provides some indication of the spatial extent of the Protestant school boards of Quebec. The sample for this research study was drawn from the Eastern Townships School Board (#5 on the map).

This study employs an activity-based approach to determine the spatial and temporal constraints that are experienced in the delivery of educational services. A case-study of households in the Eastern Townships School Board is used to analyze the ways in which individual students and other members of the household adapt to the constraint of daily bus travel.

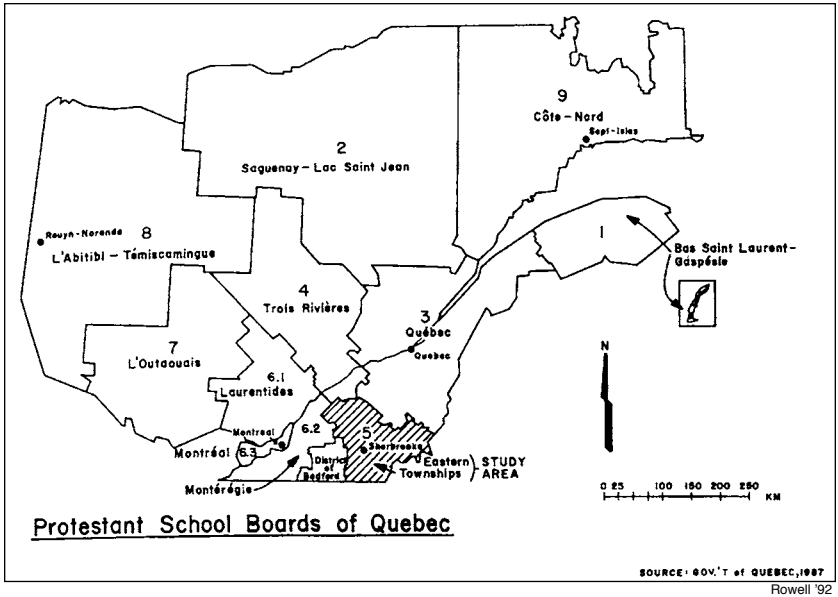

Figure 1.

Research Questions and Hypotheses

This study seeks to answer some fundamental questions about the constraint of extended school bus travel, questions posed daily by families living in the Eastern Townships region:

1. To what degree does distance(either physical or temporal) have an effect on school choice and utilization? Are households dissuaded or prevented from using schools because of these distance factors?
2. What has been the effect of extended time spent in a school bus on the student's home life? (i.e. daily activity cycles, recreational activities, friendship patterns, family commitments, etc.)
3. What are the attitudes of household members toward the trade-off of time for the services offered within the regional school system?
4. What has been the effect of time-distance on the student's association with the local community in matters such as community activities, associations, shopping and recreation?
5. What have been the effects of daily bus transport on the student's perception, behaviour and achievement in the school

environment in matters such as attendance, homework, grades, social interaction, school size, friendship patterns, extra-curricular activities?

6. To what degree do students and parents perceive accessibility as a factor in the quality and delivery of a public service?
7. To what degree do students and their families see the school bus trip itself as a constraint? To what degree would alternative modes of transportation (walk, bicycle, automobile) to school affect their household behaviour?

The research questions addressed here require an understanding of the decision rules guiding a household's day-to-day behaviour. Investigation of how household members adapt to the time-distance constraint of daily bus travel requires analytic techniques that go beyond the traditional methods and models of transportation planners. For this reason, the Household Activity-Travel Simulator, or "HATS," developed at the Transport Studies Unit at Oxford University, was adapted to a survey of households in the Eastern Townships School Board.

The Household Activity-Travel Simulator is an interactive social survey techniques for understanding the inter-relationships between attitudes and behaviours (Jones, 1978). The HATS survey method allows all of the members of a household to depict their daily pattern of activities in time and space on a display board (Figure 2). The use of a simulation-display board approach is only part of an overall in-depth survey where family members discuss the reasons underlying existing behaviour. At the same time, the HATS technique is used for simulating how these same households would react to changes in their daily lives, such as longer or shorter periods on a school bus.

Since the problem addressed in this research relates to time as a constraint, the sample of households was selected according to the travel time from home to school by bus. By selecting households according to travel time, the researcher can test for differences in household behaviour in terms of this factor. In this way the fixed travel mode is measured according to the actual time spent on a school bus. As time-distance varies, one may search for differences in the student's perceptions, activity choices and durations, household and social attitudes and activities, and attitudes toward the school and the school system. Data derived from the Eastern Townships School Board student and household interviews and HATS gaming simulation were collected to analyze and test the

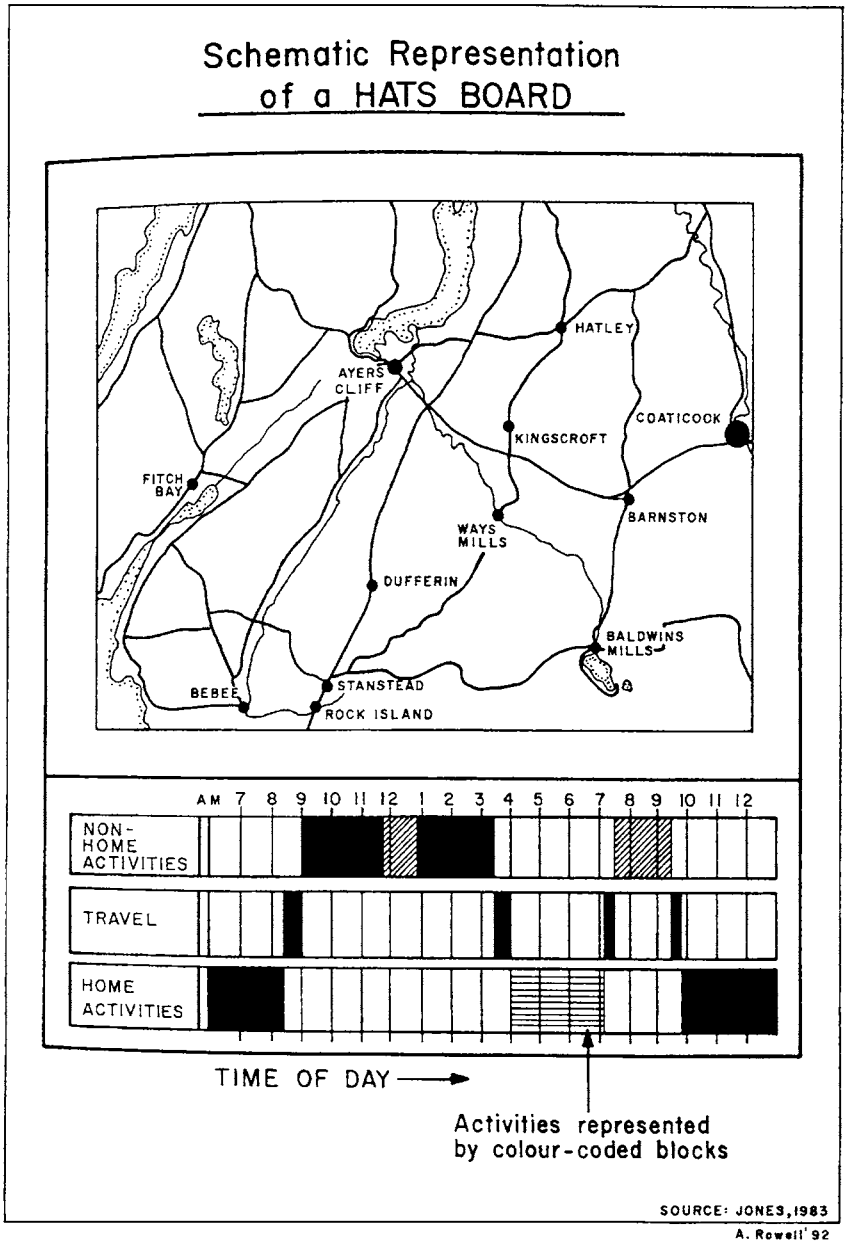
Schematic Representation
of a HATS BOARD
HATLEY
AYERS CLIFF
KINGSCROFT
COATICOOK
FITCH BAY
BARNSTON
WAYS MILLS
DUFFERIN
BALDWINS MILLS
BEBEE
STANSTEAD
ROCK ISLAND
AM 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
NON-HOME ACTIVITIES
TRAVEL
HOME ACTIVITIES
TIME OF DAY
Activities represented by colour-coded blocks
SOURCE: JONES, 1983
A. Rowell '92

Figure 2.

following research hypotheses:

Hypothesis 1

As travel time increases, there is a greater degree of household adaptation. Specifically, those at greater distances will display a higher degree of household adaptation by engaging in fewer activities.

Time spent on a school bus will vary according to distance from the regional secondary school. Some students in the sampled area ride on a bus for as little as thirty minutes round trip, while others may have to spend over 240 minutes (4 hours) on the bus per day. Since all students must be in school for the same time period, 9:00 a.m.–3:13 p.m., those at greater distances are required to board the school bus earlier and to be delivered home at a later hour than those living closer. Thus, as the travel time increases, students have fewer minutes of the day available for all other activities. It is hypothesized that these students will have to adapt to the time constraint of the bus ride by selecting fewer activities within a given school day.

Hypothesis 2

As the travel time increases, secondary school students will devote less time to in-home and out-of-home activities.

The time constraint will affect all possible activities, including the basic activities such as personal care, meals, homework, and even sleep. As a result of the long hours on the school bus, students will have little interest or opportunity for "optional" activities, such as community activities, recreational or social activities.

The earlier the bus pick-up, the earlier the student must rise in the morning. Likewise, the farther that student is from school, the later he or she will arrive home in the evening. It is hypothesized that such a constraint will require that student to go to sleep at an earlier time in the evening, as well as limiting involvement in any sort of after-school or extra-curricular activity at the school.

Hypothesis 3

As the student travel time increases, there will be an increase in the secondary constraints (number of activities and time spent in activities) on other household members.

This hypothesis suggests that, as the duration of students' bus travel increases, it has a greater effect upon the daily routines of their parents and siblings as well. The individual student's daily activities, including the time required to ride on a school bus, will have an effect on the choice, timing and duration of other house-

hold members' activities. For example, if a child must rise at 6:00 a.m. in order to meet the school bus at 7:00 a.m., he or she may require assistance from one of the parents in getting up, completing household chores, fixing breakfast and getting out of the house on time.

If a student does participate in an extra-curricular activity, a secondary effect may be the need for a parent to drive to the school and collect the child. If a child arrives home at a later hour, family members may have to re-arrange their activities to coincide with the student's schedule, such as meal time or shopping.

Hypothesis 4

As the school bus travel time increases, households will indicate greater levels of dissatisfaction with the delivery of educational services. Households will indicate reduced levels of student achievement in the areas of attendance, academic standing, social interaction (school and community), and extra-curricular activities.

This hypothesis suggests the time devoted to the journey to school causes fatigue, a reduction in the level of attention while in school, the time available to complete homework assignments and/or the ability to participate in extra-curricular activities and sports. Students and families were asked whether transport time has an overall effect on grades achieved. Do students living closer to the schools exhibit higher levels of achievement than those at the extremes of the school district?

Evaluation of this question will allow investigation of any possible trends in how the school system itself is perceived. Do family members believe that their social and recreational interaction is limited by the loss of a community school system? What is their attitude towards these large, regional schools? What effects does the forced bus ride have on their children? What effect does the bus ride have on the social interaction of the students themselves?

Hypothesis 5

Farm households, being involved in a greater number of in-home activities, will be constrained by student bus ride times to a greater degree than those in urban or non-farm households.

It is suggested that farm households spend more time, on average, participating in in-home activities than do non-farm household members. Because of the nature of livestock and dairying in the region, it is likely that farmers cannot change their schedules as easily as others: farm chores must be performed regularly. If this is indeed the case, farm households will display very little flexibili-

ty in their schedules, and the daily bus ride of certain family members will further reduce flexibility and increase stress in the household.

Students themselves may be required to meet activity demands from in-home, farm-related activities, as well as the time demands of the bus ride and the school day. These individuals may have their daily activity choices and timing sequences reduced to a greater degree than non-farm students. These students may display a greater sensitivity to the travel time constraint.

Hypothesis 6

There will be some critical point at which households find the travel time to be too great. At that point, households will radically restructure their activity patterns. They may: change mode of transport, change school system, or change household location.

While the focus of this research is on families whose children attend the secondary schools of the Eastern Townships School Board, it should be noted that one available adaptation would be to remove their children from this school board and enrol them in an alternative school system. Under Quebec law, English-speaking students have total access to French-language schools. Families that wish to change their child's place of schooling must apply for an "Inter-Board Transfer." The Eastern Townships School Board receives between two and three hundred of these requests each year. The geographical aspect is, of course, only one of many factors involved in the choice of a particular school. Other factors include language of instruction, course offerings, confessionality, school size and structural aspects, and the perceived quality of instruction being offered.

These Inter-Board transfers allow for the distance constraint to be tested as a possible factor in school choice. Distance measurements were calculated for all secondary school transfers recorded for the 1990 school year (105 students). Time and distance from home to school was measured for both the former regional secondary school and the present French language secondary school. This information allows estimation of the effect of time and distance factors in school choice, if in fact the inter-board transfer resulted in a reduction in the distance travelled from home to school.

The proximity of the Eastern Townships school board to neighbouring schools in the United States has also raised the possibility of households living along the border choosing to send their chil-

dren to these institutions (Wolforth and Rebuffot, 1984). Again, distance is hypothesized to be one of the factors that would be considered by these families, as well as the fact that these schools offer the only real alternative public, English-language school system to that of the Eastern Townships Board. To this end, school officials in eight secondary schools in seven communities in Vermont and New Hampshire were interviewed in order that the number of former Eastern Townships secondary students could be estimated.

One final possibility for families attempting to minimize the distance that their child has to travel to an English-language secondary school is to enrol that child in an independent school. Since Bishop's College School is located only three kilometres from Alexander Galt School in Lennoxville, only Stanstead College, located on the Vermont border, was contacted to determine the number and addresses of students attending the school but residing within the Eastern Townships. Again, there are a number of factors involved in the decision to attend such an institution, however the time-distance constraint can be measured and tested as *a* factor in the decision.

Geography and the Regional School System

The reorganization of governmental structures for education has been a contentious issue in North American communities. The implications of such a process have been analyzed in a number of areas of geographic research and literature, such as the spatial structure of administrative systems (Forrest, 1981; Massam, 1972; Abler et al., 1971), the allocation — location problem (Maxfield, 1972; Yeates, 1963), and the social and behavioural geography of education in the community (Herbert, 1976; Eggleston, 1967; Harriott, 1966).

While a number of these studies have focused on the allocation of facilities within the urban area, or the relationship between the journey to school and academic achievement (Dunlop, 1957; Alexander, 1975; Bidwell, 1975; King, 1984), little attention has been paid to the effects of time and distance to school on the attitudes, spatial choices and behaviours of educational consumers.

This study identifies the social and spatial constraints experienced by students and their families within a large, regional school network. Analysis of the survey data allows the researcher to identify both the social costs and the future needs of regional school clienteles. This information assists in providing some spe-

cific solutions to stated research questions and will provide the basis for broader policy applications and theoretical implications in the geography of education.

This study is also significant because it attempts to investigate a number of issues in the spatial organization of educational services. Under the law, all children in Quebec, indeed Canada, must receive adequate educational services. How far should children be expected to travel in order to receive this basic service? Has time-distance any effect on perceptions and attitudes toward school? These questions have not been investigated in Quebec. School board territories have been drawn and redrawn, and from time to time local schools have been closed, but these spatial questions remain unanswered.

The delivery of educational services in an area as expansive as Quebec is indeed a formidable task. Schools strive to overcome constraints such as dwindling numbers of students and tax dollars on the one hand, and the need for schools large enough to support viable academic and athletic programs on the other hand. As Kirby (1982) suggested, there must be some spatial distribution of schools, as well as some adequate system of allocation. This research is designed to test the effect of the journey to school on the daily lives of household members, and their satisfaction with the delivery of educational services.

The use of a Household Activity-Travel Simulation approach in a geographic study has a significant research role within the larger body of human activity literature. Such research focuses on how people allocate their time among different activities. This research study, an activity-based approach to household behaviour, can be viewed within this wider field of human activity and transport research, such as previous studies by such authors as Chapin (1965), Fried (1977), Carlstein, Parkes and Thrift (1978), Parkes and Thrift (1980) and Jones (1983).

An important element of this research is an understanding of human activity as it relates to transportation geography and travel constraint. The work by Hagerstrand (1970), like the current HATS approach, is important in understanding the space-time constraints on individual or household choice imposed by psychological, economic and cultural elements.

Data in human activity research is often collected by utilizing some form of written diary that asks what each respondent is doing, when and where, and may also include questions about why or with whom each activity was carried out (Jones, 1983b).

Since this research study uses such an approach, the geographic literature on diary format and usage adds to the work of Hedges (1974), Thrift (1977), Chapin (1974), Cullen (1975) and Fox (1991).

Significance of the Study

The use of the HATS interactive survey methodology facilitates the testing of the six hypotheses. The research atempts to answer a fundamental question that has long gone unanswered in Quebec: *What is the effect of extended periods of time spent in a school bus on household activities and behaviour?*

The research methodology is important because it allows for the simulation of how households might react to changes in their daily lives, such as longer or shorter school bus rides. This "what-if?" scenario allows for a more complete understanding of the distance constraint by allowing individual family members to record their daily schedules and behaviours. The HATS method allows individuals and families to express their preferences on the household activity board used in the interview.

In planning the delivery of school bus services, administrative policies should include the effects of changes on those directly involved — students and their families. This study looks at the behaviour of households when constrained by a daily school bus schedule, as well as the processes behind their revealed behaviour.

The selection of the Household Activity-Travel Simulator allows the research to expand beyond the current behaviour exhibited by households to the study of possible policy changes and the restructuring of household activity patterns. A second application of the HATS technique will allow for the analysis of household responses to a hypothetical policy change in school bus timing.

The Household Activity-Travel Simulator has been used in several geographic studies involving changing school hours, the withdrawal of rural bus services and the improvement of urban transit services. This study uses the HATS approach to investigate rural school transportation as a constraint on households and their resultant decision-making processes and activity choices. In this way the research has both practical benefits in terms of school board policy, as well as an improved theoretical understanding of human activity, household behaviour and the behavioural geography of such processes.

The Eastern Townships School Board

The various research questions were tested by using the HATS technique on a stratified sample of households selected from the Eastern Townships School Board. The Eastern Townships School Board (ETSB) represents an area of Quebec that is both rural and urban, has experienced the centralization and elimination of schools and school districts, and has been charged with the delivery of educational services to an expansive region of the province. The current school board, formed in 1984, represents amalgamation of the St.Francis School Board, the Lennoxville District School Board and the Eastern Townships Regional School Board. The map of the Eastern Townships School Board territory (Figure 3) indicates the size of the Board, an area of 15,000 square kilometres — an area larger than the province of Prince Edward Island. The board administers eleven elementary schools, two regional secondary schools, an adult training centre, and a special projects school. It should be noted that eight French-language school boards operate within the same general boundaries of the Eastern Townships School Board. They administer school services to 105 elementary and special education facilities, as well as 18 secondary schools.

The households interviewed for this study have family members attending one of the two English-language regional secondary schools: Alexander Galt Regional Secondary School, located just east of the town of Lennoxville, or Richmond Regional Secondary School, located on the edge of the town of Richmond, Quebec. Both schools were constructed in the late 1960s, a time when English school enrolments in this area were quite stable. There has been a steady decline in enrolment since that time. While Alexander Galt School opened with over 3,300 students, current enrolment equals 965 students. Richmond Regional School opened with 1,000 students, while 1992–93 enrolment was 326 students (Eastern Townships School Board, 1993).

The majority of students (87%) living within the Eastern Townships School Board are transported to school by bus each day. In the case of secondary students, virtually all of them are bussed each day. On a normal operating school day, 3,447 students, from kindergarten to Secondary V (Grade 11) are brought to school on 73 school busses, covering 10,500 kilometres per day (over 2 million kilometres each school year).

The Eastern Townships School Board is the only remaining Protestant school board in Quebec to own and staff a complete

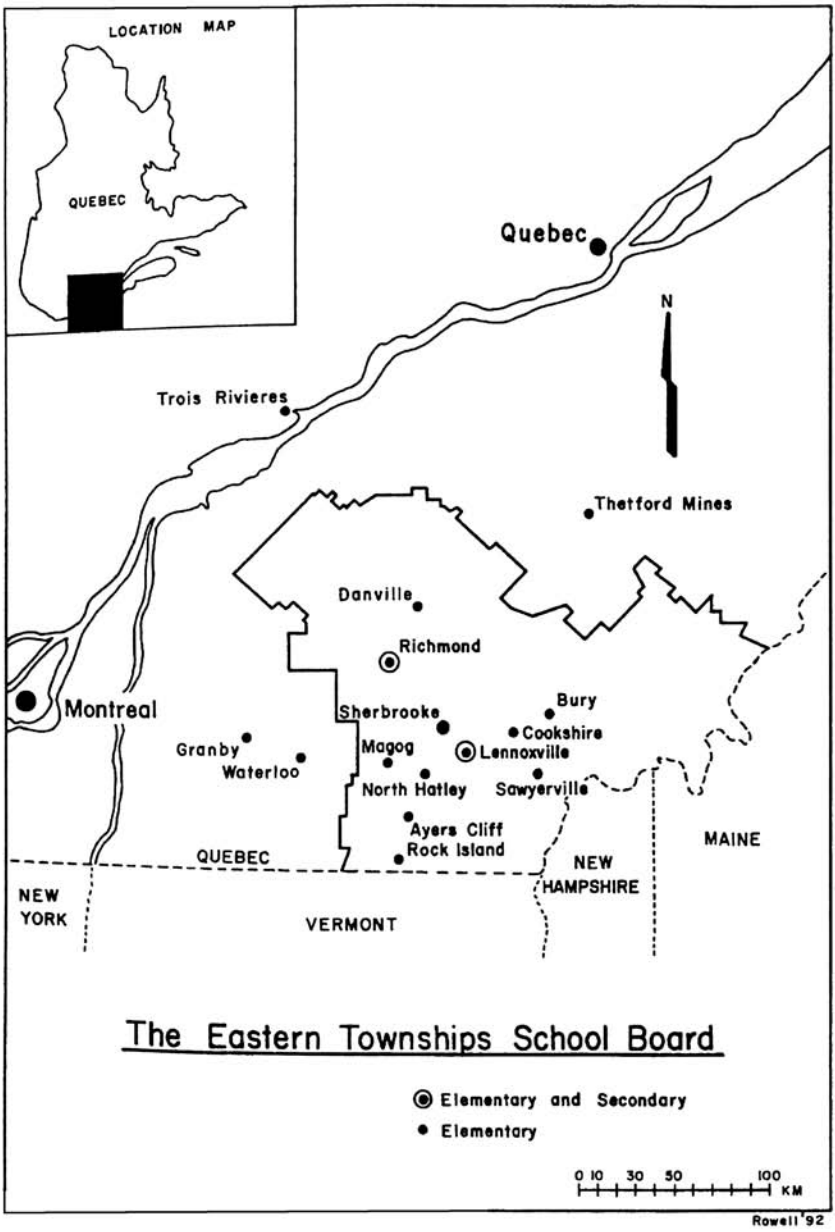
LOCATION MAP
QUEBEC
Quebec
N
Trois Rivieres
Thetford Mines
Danville
Richmond
Montreal
Sherbrooke
Bury
Cookshire
Granby
Waterloo
Magog
Lennoxville
North Hatley
Sawyerville
Ayers Cliff
Rock Island
QUEBEC
MAINE
NEW HAMPSHIRE
NEW YORK
VERMONT
The Eastern Townships School Board
Elementary and Secondary
Elementary
0 10 30 50 100 KM
Rowell '92

Figure 3.

fleet of school busses. Most other boards allocate funds to school transportation companies on the basis of offers of tender. For this reason, the Eastern Townships School Board represented an ideal sample area with complete, accessible records on the delivery of school transportation services.

Sampling and Survey Procedure

Figure 4 provides a summary of the "HATS" survey procedure followed in collecting household information and attitudes on the various research hypotheses. The Eastern Townships School Board provided the names, addresses, telephone numbers and bus route information of all households being served by the Board. The household sample was constructed from families that had at least one child attending one of the two regional secondary schools. Sample households were selected from locations along school bus routes at thirty minute time-distance intervals: under 30 minutes, 30–60 minutes, 60–90 minutes, 90–120+ minutes of one-way travel from home to school. The selection procedure also attempted to separate those households that could be classified as "farm" and those classified as "non-farm."

Family members were asked to complete a one day activity diary for a regular school day, providing details of what they did throughout the day, when and where. Family members were then asked to display their recorded behaviour for the diary day on a HATS game board. The board is marked out in time periods through the day, with separate rows for "in-home," "out-of-home" and "travel" activities. Household members were given non-permanent, coloured marking pens to indicate activity types and time blocks. Each household was also provided with a large, plasticized map of the Eastern Townships region and the various bus routes were indicated on the map.

Family members were asked to outline their daily activities by placing events within the following basic activity groupings:

A Sleep	H Work/employment
B Personal Care	I Social activity/relaxing
C Meals	J Recreation
D Domestic Chores	K Walking
E Shopping/services	M Bus
F School	N Automobile
G Homework	O Other mode

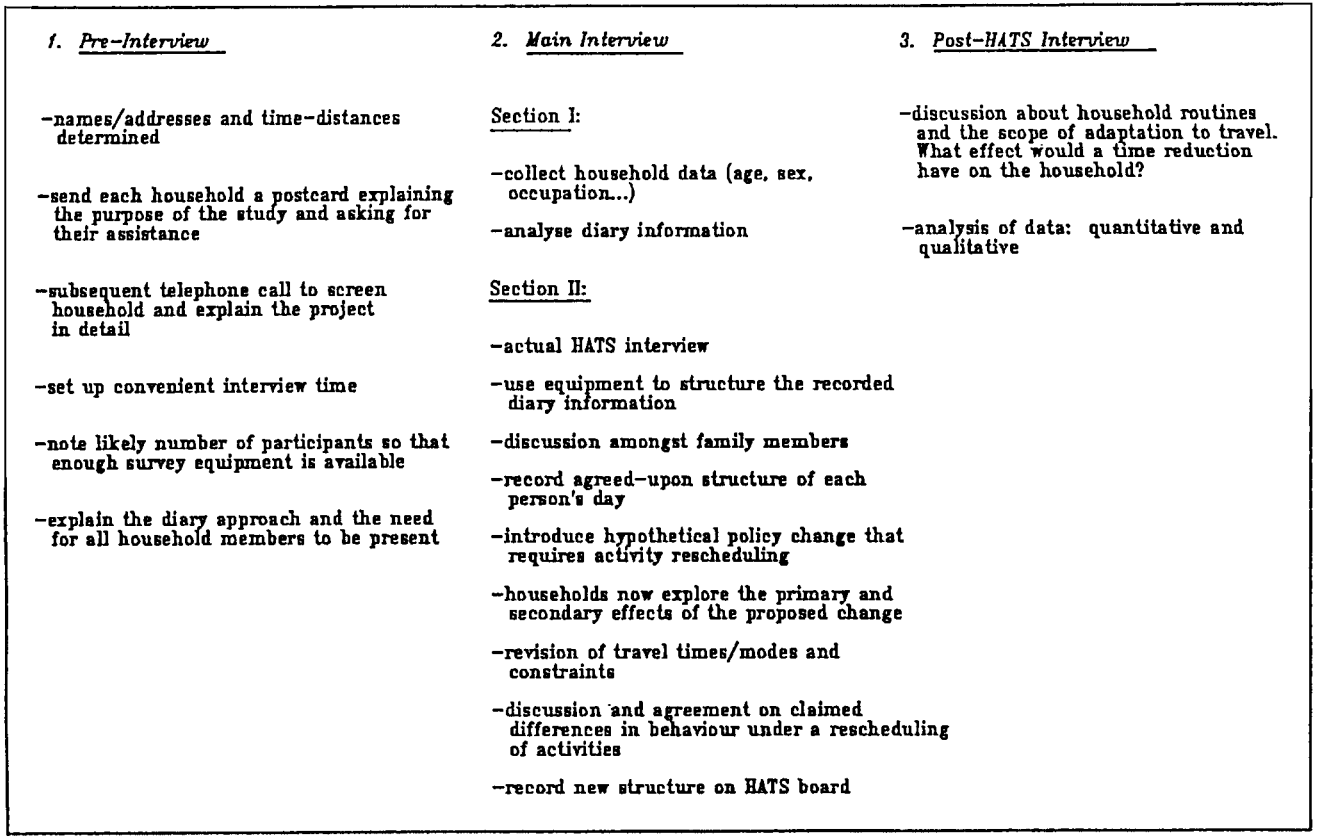
1. Pre-Interview
-names/addresses and time-distances determined
-send each household a postcard explaining the purpose of the study and asking for their assistance
-subsequent telephone call to screen household and explain the project in detail
-set up convenient interview time
-note likely number of participants so that enough survey equipment is available
-explain the diary approach and the need for all household members to be present
2. Main Interview
Section I:
-collect household data (age, sex, occupation...)
-analyse diary information
Section II:
-actual HATS interview
-use equipment to structure the recorded diary information
-discussion amongst family members
-record agreed-upon structure of each person's day
-introduce hypothetical policy change that requires activity rescheduling
-households now explore the primary and secondary effects of the proposed change
-revision of travel times/modes and constraints
-discussion and agreement on claimed differences in behaviour under a rescheduling of activities
-record new structure on HATS board
3. Post-HATS Interview
-discussion about household routines and the scope of adaptation to travel. What effect would a time reduction have on the household?
-analysis of data: quantitative and qualitative

Figure 4.

The household survey/interview also solicited student and parent responses to questions about time and distance, transport needs, their constraints and costs, and about their attitudes toward the effectiveness of large regional school systems. In total, 64 households were interviewed, with a total of 266 individuals taking part. Of these 266 individuals, 94 were actual secondary students, the remaining number being other household members. Each household interview was conducted by the author, with each household survey and interview taking two to three hours to complete. The households surveyed in this sample represent about six percent of the total number of households in the Eastern Townships School Board.

Introduction of a Policy Change

The "HATS" approach provides an opportunity to study possible policy changes and the restructuring of household activity patterns. After the initial representation of household activities under existing travel constraints, sample households were asked to react to the following policy scenario:

> A number of school boards have introduced a system of smaller, faster mini-busses to bring students to and from their schools. Such systems have reduced the travel time by as much as 50 percent. Using the HATS display board, restructure your daily activities as if the travel time to school was reduced by 50% going to school, and 50% coming from school.

The concept of service improvement facilitated an analysis of the non-travel and travel adjustments by each member of the household. It allowed for a comprehensive measure of behavioural change through the reallocation of time, at both the individual and household levels.

This second application of the HATS technique allowed for the analysis of household responses to a possible policy change. Three areas of behaviour may have been affected: 1) the direct change in the school journey for the students involved; 2) adjustments to in-home activity patterns; 3) secondary effects on other household members, their travel and out-of-home activities.

Analysis and Results of the Study

The Household Activity-Travel Simulator study of households in the Eastern Townships School Board provided a wealth of individ-

ual and aggregate data. In total, 64 households were interviewed over an eight month period. The interviews provided two very useful sources of data — that information that reveals the current situation of bus times and household behaviour ("before"), and those changes that would have been made if the hypothetical reduction in bus times was implemented ("after"). Thus, the "before" category is the representation of what actually happens to students and their families each school day. While the "after" category is useful in measuring the probable differences in activity behaviour, it is only the residents' perception of what might occur.

The HATS technique proved very powerful in uncovering both qualitative and quantitative data. Each completed HATS board was coded and entered into a computer file. The data was divided into "before" and "after" categories for each individual. Printed tables of each individual's and household's responses were analyzed to provide individual differences and modifications, as well as aggregate changes to various activity choices and durations.

Each of the six hypotheses was analyzed under the "before" and "after" scenario, as well as the "differences" between the two schedules. Several of the hypotheses deal with the impact of the bus ride on the students themselves; others deal with the indirect effects of the school bus ride on the daily schedules of other family members. The quantitative measure of these factors was completed using multiple regression analysis, factoring out the role of variables other than the daily bus ride. In addition, two types of regression diagnostics were used to (a) identify non-linearities or non-uniform error distributions and (b) identify points that inordinately influence fit. Regression diagnostics such as these allowed for the determination that any relationships that were found to be linear were not the result of abnormalities in the distribution, and provided significant levels of confidence in the results of testing activities against bus time.

The nature of this article, as well as space limitations, demand only a brief discussion of the quantitative and qualitative results of this study. The findings relating to each of the six hypotheses are reported on the following pages. To facilitate identification and referencing, each section is introduced by the hypothesis being considered.

One very clear finding was that secondary students attending schools in the Eastern Townships School Board have a significant time constraint placed upon them by the scheduled bus ride they

must endure each day. This daily time constraint goes beyond the individual student to pose a number of secondary constraints on other household members. The school day becomes a complicated scheduling of events, from rising at very early hours in order to meet the bus, and arriving home well after dark on many days. This fixed constraint expands the school day beyond the usual 9:00–3:30 routine of many urban school systems.

The household interviews also indicated a significant concern over the size of the school district and the influence size has on school bus schedules and the time-distance factor in getting students to school. The fact that there are only two secondary school in this large region suggests that there is a large distance between home and school, and there is a significant time constraint associated with the delivery of educational services in this region.

The fixed nature of this mode of transport makes it difficult for any personal or household flexibility in scheduling or participating in events. Household interviews revealed that the lack of participation and communication cause stress on students and their relationships with school, out-of-school activities, and friendship patterns. For example, many students have friends that live in various parts of the school board region. The distances may be so great that a simple telephone call involves long distance charges to be made. For those who wish to meet out of school hours, only week-ends may be possible, involving family members acting as chauffeurs or sleep-overs being needed. Again, distance places a constraint on the individual student and his or her relationship with family and friends.

The household interviews also revealed a number of parents who were concerned about what goes on *inside* the school bus as it travels these long distances each day. The typical school bus will carry 55–72 students, from age 5 to 17 years. This forces children into a very unnatural social group situation and parents worry about the development of children in such situations, with specific concerns over the use of drugs, violence and the psycho-social maladjustment that may develop. Virtually every household had at least one situation that placed the student in a stressful situation while riding the bus. The typical complaint was that the younger children "mature too quickly", and the older children "are too immature." Of the 64 households, 7 had sought professional help for the psychological problems students developed from riding on a school bus each day. It should also be noted that the Eastern Townships School Board has one of the strictest school

bus behaviour policies (known as the Code of Conduct) in Quebec, with Board-owned busses and well trained, experienced drivers.

Hypothesis 1

As travel time increases, there is a greater degree of household adaptation. Specifically, those at greater distances will display a higher degree of household adaptation by engaging in fewer activities.

The severity of the travel time constraint varies, from a minimum of 30 minutes per day on the bus, to 300 minutes per day. Each student and his or her family develop a complex system of activity scheduling as a result of this constraint. As expected, as distance increases, students participate in fewer activities and have less time to participate in them. When the number of activities was regressed against a standard list of independent variables included as controls, the only significant one was the duration of the bus trip.

This first hypothesis is supported by the data gathered during the household interviews. The initial ("before") activity boards, where students depicted their current behaviours, revealed that for each additional two hours round trip, about one less activity is engaged in. Those students living in the outlying areas of the school board must adapt their daily activity behaviour to a greater extent than their peers living closer to the school.

When the "after" activity board results are regressed, we see the relationship between the reduction in travel time and the increase in the number of activities students believe they would engage in. The regression results support the hypothesis that students will engage in a greater number of activities, the more travel time is reduced. In this "after" type of regression, only the reduction in bus times had a significant effect on the number of activities.

While these results are statistically significant, thus supporting the first hypothesis, it must be noted that they only represent a marginal change in the number of activities due to the halving of bus times. That is, for each hour of round trip time saved on a school bus, the net result would be an increase of only one-half of one activity.

Hypothesis 2

As the travel time increases, secondary school students will devote less time to in-home and out-of-home activities.

From the anecdotal information provided by the 94 secondary student interviewed, it was found, as expected, that students who

spend more time on the school bus are engaging in fewer different types of activities and they believe that they would devote more time to a greater range of activities, if they had their bus times halved. From a subjective point of view, this finding is consistent with the initial hypothesis and the whole logic of a scheduling constraint. Students reported that this type of constraint is detrimental to their lifestyles, as they must selectively change their activity behaviour to compensate for lost time on the bus. Ultimately, this may cause them to exclude activities that they would normally pursue, if they did not have to be on the bus.

The quantitative analysis of the amount of time students spend in the various activities, such as sleep, homework and recreation regressed against bus ride time, tells a different story. From a list of twelve different activities regressed against bus time, only four displayed a significant relationship. The "before" regression analysis on sleep revealed only a marginally significant effect, suggesting that sleep time was not seriously compromised by increased journey time. The "before" results also found that a student will spend five minutes less in personal care for every extra hour they ride on the bus, and just under five minutes will be added to riding in an automobile for every hour less of bus time.

Only recreational activities demonstrated a clear time-distance decay, where the hypothesis is supported by regression results that show that for every hour that a student does not have to ride on a bus, half of that time saving is spent in recreational activity.

The quantitative analysis is based on the regression results of the "before," the "after" and the "difference" in the amounts of time devoted to each activity. The "before" regression looks at how much an activity actually increases or decreases as a proportion of a unit of time according to round trip travel time. The "after" regression lets us look at the relationship between the hypothetical trip time and how long students believe they will spend on any given activity. The "difference" allows us to look at the relationship between the reduction in travel time and the increase or decrease in time spent on any given activity.

The analysis of the "before" data allows us to conclude that the duration of the daily bus trip is by far the most, and often the only, significant variable affecting the actual duration of certain activities, but it has a statistically significant bearing on only four of twelve activities. These results, while they tend to support the hypothesis, raise a question about their social significance.

One benefit of the HATS method is the fact that students and

their families were allowed to react to a hypothetical change in their daily schedules. They were allowed to indicate how they believe they would change the timing and selection of activities, and thus, the "after" and "difference" regression analyses facilitated a quantitative component to household's perceived behaviours. It is only at this stage that we can relate student's subjective, anecdotal reports of behaviour with their reported reactions to a reduction in bus times, as seen in the "after" activity schedules. The quantitative results of the analysis of these schedules allows us to conclude that, for the duration of many of these students' daily activities, perceived or anticipated behaviours are often quite different than actual recorded behaviours. For example, although the time spent on the bus is marginally associated with the amount of time students actually sleep, the analysis of the perceived change in sleep time as a consequence of travel time being halved revealed extraordinarily high expectations of time being devoted to extra sleep before boarding the bus each morning. Results such as these allow us to conclude that there is sometimes an inconsistency in what people believe they will do with increased discretionary time, and what reality shows they actually do with it.

Hypothesis 3

As student travel time increases, there will be an increase in the secondary constraints (number of activities and time spent in activities) on other household members.

This hypothesis looks at the parents only, suggesting that, as their child's time on the bus increases, it will have an effect upon the number of activities they engage in, as well as the amount of time spent in each. The regression results of the "before" schedules support the hypothesis that the longer the student travels by bus, the fewer the number of different activities in which his or parents will engage. The results indicate that the only significant variable is the duration of the daily bus trip. However, the results indicate that this reduction in the number of activities is marginal, showing that for every hour more that a child rides on the bus, the number of activities by a parent falls by only a quarter of one activity.

About one-third of the 126 non-students reported that they would not alter their daily schedules at all, even in light of a reduction in their child's bus times in the "after" scenario. Although the "after" regression results support the hypothesis that student bus time will have secondary effects on other family mem-

bers, the relationship is only marginal. From this we can conclude that, in terms of student and parent activity numbers, the proposed change in bus ride time would have a much greater effect upon the students themselves and only a marginal impact upon their parents.

Regression analysis was also completed for the time parents spent in each activity, both before and after the hypothetical halving of childrens' bus times. Only two of the twelve activities, relaxation and use of an automobile, showed any relationship with student bus time. While parents living in areas where travel time is the shortest will tend to use the car more often, supporting the hypothesis, the conclusion from the analysis of parents' relaxation time is that it is actually enhanced by the bus trip. The "before" results show that relaxation time increased by about one-third of a time unit for each unit increase in bus time.

The "before" regression results for the other variables, such as meals, personal care, sleep and recreation, do not statistically support the hypothesis that the bus time constraint on their children has a negative secondary effect on the timing of parents' activities. Similarly, the results of the "after" regressions do not statistically support the hypothesis that, given a reduction in their children's bus times, parents will increase the time they spend in these activities.

Hypothesis 4

As the school bus travel time increases, households will indicate greater levels of dissatisfaction with the delivery of educational services. Households will indicate reduced levels of student achievement in the areas of attendance, academic standing, social interaction (school and community), and extra-curricular activities.

Regardless of distance, students suggested that they do less homework than they would if they did not have the school bus constraint. Ninety percent of the students interviewed believed that they needed to improve the quality of their school work. Most secondary students view the bus constraint as part of the "normal" school experience. They suggest that, ultimately, the bus constraint has a negative effect on their grades. However, these subjective evaluations of the bus trip and the completion of homework are questioned when viewed beside the regression results. The regression results for the "before" scenario indicate that there is no statistically significant relationship between time spent completing homework and time spent riding on a school bus. "After"

regression results indicate that these students believe that twenty percent of the time saved on the daily bus ride would be used for completing homework. Once again, we must conclude that a student's stated versus their actual behaviours may vary considerably.

From the qualitative side of the household interviews, there was very little dissatisfaction with the actual performance of the Eastern Townships School Board. Students view the regional secondary school as a place to satisfy both academic and social needs. They have a larger choice of social paths but friends are spread over a wide geographic area, causing further time or distance constraints in their daily activities.

In terms of extra-curricular activities, where students remain at school after classes have concluded, the regional school system has had a number of difficulties. Since all of the students travel by bus, it is extremely difficult to arrange for them to return home after sports, club meetings, activities, etcetera. A "late bus" is offered to students taking part in extra-curricular activities, however, it must travel over the entire school board to drop students off, adding a huge travel cost to the individual student. In these instances, the average student would not arrive home until 7:30–9:00 p.m.

When the percentage of students living in the four distance ranges from Alexander Galt Regional Secondary School were analyzed according to those students that actually participated in extra-curricular activities, a clear pattern emerged. Table 1 shows that the participation rate declines steadily with increased distance from the secondary school. Participation rates were determined by finding which one way time-distance group the members of each extra-curricular activity fell into: less than 30 minutes, 30–60 minutes, 60–90 minutes, 90 minutes or more. Activities included such things as: football, soccer, basketball, hockey, skiing, softball, badminton, academic clubs, social clubs, volunteer groups, etc.

TABLE 1:
Extra-Curricular participation according to distance from Alexander Galt Regional Secondary School.

Distance *(minutes)*	*< 30*	*30–60*	*60–90*	*> 90*
Total number of participants	158	156	55	13
Total number of students	308	345	501	181
Percentage	51%	45%	11%	7%

Distance to school, and the nature of the daily school bus trip as a fixed activity, have a definite effect on the ability of students to participate in extra-curricular activities. Both regional schools experience great difficulties in attracting sufficient numbers of students to create viable athletic teams or social activities. Those within a reasonable distance of the school tend to participate to a much greater degree. It takes a concerted effort by those from greater distances to participate in their school's non-academic activities. As one student stated:

> *I've always been interested in playing sports, but it's never worked out. I used to play hockey but it would be 9:30 p.m. before I got home. In the end I quit the team because my grades went down, I was dead tired and my Dad was sick of being my chauffeur.*

Each of the households surveyed indicated that the time devoted to the journey to school each day causes fatigue, a reduction in the level of attention while in school, the time available to complete homework, the ability to participate in extra-curricular activities and sports.

Perceptions of the schools and the school system seem to be associated with the daily transit constraint. Many parents questioned the need to have their children travel such long distances, but very few alternatives were ever suggested. An analysis of the household survey information reveals that travel has become a significant activity in their daily lives. Households must operate within a complex system of time allocations, activities and behaviours.

The presence of the school bus constraint contributes to the overall impression households have of the school system. The daily bus trip is viewed as a constraint by the students themselves, as well as the other members of the household. The transportation factor is a derived demand, since students need to get to school. However, the fixed nature and extreme demand on time have made this activity particularly severe on households living in the Eastern Townships School Board.

Hypothesis 5

Farm households, being involved in a greater number of in-home activities, will be constrained by student bus ride times to a greater degree than those in urban or non-farm households.

The attempt to distinguish farm families from others produced less satisfying results because of the small proportion of full-time farm families in the sample (21 families). In fact, very few tradi-

tional farms operate in this region of Quebec. Most of those listed as farms found that individuals were primarily engaged in farming, yet other income was derived by activities away from the farm. Most households displayed some evidence of employment away from the farm, either through one of the parents working or part-time employment in addition to their work on the farm. This fact suggests that parents in farm households would already be very constrained in their daily activity scheduling, even before their child's activity schedule was considered.

Data for the 21 families of this type — most of them combined farming with other activities — was consistent with expectations: farm households do participate in more in-home activities than other households, yet there were very few statistically significant relationships found between the far/non-farm variable and any of the dependent variables used in the regression models. It is only through the qualitative interview data that we are able to suggest that the school bus constraint adds to the complexity of the farm household's daily activity schedule, thus being constrained to a greater degree than non-farm families.

Hypothesis 6

There will be some critical point at which households find the travel time to be too great. At that point, households will radically restructure their activity patterns. They may: change mode of transport, change school system, or change household location.

Of the 105 students identified, who changed school systems according to an inter-board agreement, all experienced a significant reduction in the time from home to their new schools, with 94% of them now living within a 30 minute trip to school. The most significant finding is that each of these students can now walk or be driven to school. Each student is now free of the daily bus ride. The transfer of schools and the elimination of the bus ride adds as much as two hours to these student's daily schedules.

Of the 18 students studying at American schools, all travel 30 minutes or less by car to school each day, as opposed to a 90–120 minute ride by school bus to the regional high school in Lennoxville. As one indicator of the presumed benefits of the alternate schools, additional costs in the form of tuition range from $2000–$5000 (American) per school year.

Of the 20 day students attending Stanstead College, a private, English secondary school, all walk or are driven 30 minutes or less to school each day at a cost of over $10,000 per year. Within the

English public school system, each would have a 90–120 minute bus ride to the regional school in Lennoxville.

This study found evidence of households that have decided to address the time-distance problem in their daily lives. The hypothesis is supported by the significant reductions in travel time for all those who attend an alternative educational institution, and for most, the elimination of the bus ride and the addition of time that may be devoted to other activities.

Results of a Hypothetical Policy Change

One of the major benefits of the HATS approach, beyond its ability to analyze the effects of the daily school bus trip on the entire family and documenting the existing household activity patterns, was its ability to pose a hypothetical change in school bus hours and measure how such a policy change might affect the family's daily routine. It was hypothesized that a fifty percent reduction in the time spent travelling to and from school would create a number of changes in the household's daily activity behaviour.

Those directly affected by the hypothetical change — the students — were the first to make the adjustments to the activity board. Their adjustments to the board were then related to other household members, who adjusted their schedules to reflect interpersonal and travel linkages. From analyzing the second round of activity display on the board, it is concluded that the hypothetical change in bus times would have a much greater and more direct impact upon the students themselves than upon the other members of the household. The analysis of the "before" and "after" schedules also indicated that household perceptions of change were often greater than actual revealed behaviour of those living closer to the schools. A number of questions may be raised about the apparent contradiction in perceived versus actual behaviours found in this study.

Perception versus Behaviour

The Household Activity Travel-Simulator, as used in this study, focuses on the impact of the daily bus ride on the perceptions and behaviours of household members. The household interviews and resultant diary information can be viewed on three levels. On the first level, we can analyze the information as quantitative, observable data. Regression analysis allowed us to undertake an empirical

study of actual household behaviour, as seen in the "before" category of the daily schedules. On a second level, the "after" scenario allows us to view student and family perceptions of how they would alter their schedules if the daily bus times were halved. This second level allows us to view the perceptual data on a quantitative level, and it acts as a validity check on the actual versus stated behaviours of individuals. The third level of analysis is the non-quantitative, perceptual data collected during the household surveys. This information has been an important part of the HATS methodology, since it allows policy makers to understand the impact of their policies, current or proposed.

All three levels of data analysis have been completed in this study, however the quantitative analysis raises a number of questions about the predictive powers of HATS. The limited number of existing HATS studies have suggested that all three levels of measurement tend to coincide. For example, if households believe that school hour changes will have a negative impact on their morning activities, the quantitative analysis has usually supported such perceptions. Post-HATS analysis of what actually occurred also tended to corroborate household members' reported behaviours. Such results have supported HATS as a strong predictive tool in the formulation of public policy.

This application of the HATS methodology supports the HATS method in many of its findings. The HATS approach has been very effective in uncovering both actual behaviour and reported behaviour. One very clear result is that secondary students in this region have a significant time constraint placed upon them by the daily bus ride. The ability to measure actual and stated behaviours along a bus route has been unique to this study and it has provided a validity check on what individuals perceive they would do and what they do in reality. For example, if a student living 120 minutes one way from the school reports that she would increase the amount of time she sleeps or does homework due to a reduction in bus times, the analysis performed here allows us to see what students who currently live in the 60 minute distance range do with this time. The "before" and "after" scenarios measured along four bus time categories have proven to be very useful for this analysis.

The quantitative results for many of the in-home and out-of-home activities reveal that perceived or anticipated behaviours are often quite different than actual recorded behaviours. For example, students would actually spend less than one-half of the time

they would save in reduced bus time in additional sleep time than they perceive they would. Although parents report that their schedules are negatively affected by their children riding on a bus, only one-third of them would actually change their schedules as a result of a reduction in student bus times. These results raise a question about the validity of the 'what if' aspect of the HATS technique. Do all three levels of data analysis — observed quantitative data, quantitative perceptual data and subjective perceptual data — have to coincide? While this analysis takes advantage of the many strengths of the HATS approach, such as the treatment of individual behaviours, some of the results raise a serious question about the validity of the HATS method as an effective predictive tool in policy formulation. The HATS approach has a number of clear strengths in measuring how people believe their lives would be affected by a certain policy or change, yet the development of policies in light of the apparent contradiction in perceived versus actual behaviours may not prove as useful to policy makers as suggested in much of the activity approach literature.

Implications of the Study

Although the findings reported in this study relate to one specific application of the Household Activity-Travel Simulator, a number of general conclusions and recommendations can be made about the effects of the school bus constraint on students and their families. In view of the evidence uncovered in the household gaming simulations, it is now possible to restate the research problem in order that the implications of the findings may assist in future research, policy development and planning.

The Household Activity-Travel Simulator has been used to investigate rural school transportation as a constraint on households and their resultant behavioural patterns. This technique has proven to be an excellent research tool for discovering the effects of the daily journey to school for thousands of students. Until now the impact of the "fixed" transportation constraint on students and their families has not been the subject of investigation. This study has indicated that such transportation constraints do have direct and indirect effects on a household's daily activities and behaviour. While the effects of the bus constraint are much more modest than hypothesized, it is important to remember that individuals are affected by even the slightest pressure on their daily activity choices, the duration of those activities, and the complex interconnections of their schedules with other family

members' schedules.

It should be noted that the time spent in a school bus each day is only part of a longer and more complicated series of activities, especially for those students living on farms or in areas at the margins of the school board. There are a number of time-distance effects on these students, as well as secondary effects on the other members of their household. The daily bus ride has varying degrees of severity on these households. The constraint also depends on the strength of the linkages between household members. All of these factors contribute to a very complex arrangement of activity behaviours, as seen on the activity boards produced for this study. It has been through this full activity-based analysis that the processes behind households' revealed behaviours have been seen.

The delivery of school bus services has a number of spatial implications associated with it, most notably the time and distances that must be covered in bringing students to regionalized centres. This study demonstrates that there are a number of human implications associated with these spatial requirements. The household interviews allow for a more complete understanding of the effects of time and distance to school on the activities, attitudes and behaviours of these households.

This Canadian investigation of a fixed transportation service adds to the international research on actual and simulated household responses to transport demand and change. The HATS methodology has been effective in confirming that individuals and households make activity trade-offs when they are in constrained situations. This method has made the time-space constraint explicit in the daily activities of these households. The hypothetical change in school board policies made it possible to identify the actual behavioural changes, as well as the changes students and parents believe they would make if the constraint were eased or eliminated. This method has been very successful in relating attitudes and behaviours to the school bus constraint in one's daily life. It has provided clear evidence of the decision-making processes that households follow when the spatial, temporal and inter-personal constraints are made explicit.

While this controlled simulation procedure was limited to the household's activities for one day, it does suggest that the analysis of each member's behaviour may be viewed as part of a larger, collective behaviour for the household. This goes beyond the more traditional survey/interview techniques and diary formats in elicit-

ing personal explanations of the daily routine, as well as the total package of inter-connected activities amongst family members, both in and out of the home. Through the household interviews, activity simulation and hypothetical change in school bus policy, this study has been able to link personal and collective behaviours with the theory that governs much of the literature on distance-decay, including the identification of some of the social costs of the spatial allocation of facilities (Taylor, 1971; Massam, 1975). Through the analysis of the various research hypotheses, the fundamental question that has given rise to this study has been addressed: the effect of extended periods of time spent in a school bus on household activities and behaviour. This study reveals that the school bus constraint does have a measurable effect on a household's daily activities and behaviour, and the severity of the effect often has a distance-decay function associated with it.

This study allows one to conclude that distance to school is more than just a physical characteristic of the school bus ride. The size of school boards, the number and quality of busses, and the social aspects of the school must also be considered in the organization of a school system. It is hoped that this research will contribute to the Ministry of Education's on-going evaluation of the "educational experience" at the local and provincial levels. Such research will facilitate transportation planning and policy-making according to *human* perceptions, social costs and behaviours.

RESUME

Dans le système scolaire régional québécois, l'autobus scolaire est devenu partie intégrante de l'horaire de l'élève et de sa famille qui doivent composer avec les contraintes complexes (temps, distance et accessibilité) qu'impose l'horaire fixe du transport scolaire. La présente étude examine la mesure dans laquelle ce trajet quotidien agit sur les perceptions et les comportements de ces ménages. On a adapté la technique du *Household Activity-Travel Simulator (HATS)*, de l'université d'Oxford, pour sonder 64 ménages de l'Eastern Townships School Board choisis selon la durée du trajet qui les sépare des deux écoles secondaires anglaises de la région. L'enquête s'intéressait aux réactions et aux comportements de l'élève et de sa famille face au déplacement quotidien en autobus. L'étude vérifie six hypothèses connexes sur les effets de consacrer autant de temps à voyager en autobus. Les hypothèses examinent les liens qui existent entre la durée du trajet

et les activités quotidiennes de l'élève et de sa famille. D'après un certain nombre de mesures quantitatives et qualitatives, l'étude conclut que le trajet en autobus a un effet sur l'élève et, dans une moindre mesure, sa famille.

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