Road Safety Impact Of
Extended Drinking Hours In Ontario

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Abstract (to be expanded)
On May 1, 1996, Ontario, Canada amended the Liquor Licence Act to extend the hours of alcohol sales and service in licensed establishments from 1 to 2 am. The purpose of this study was to evaluate the safety impact of extended drinking hours in Ontario.

Three competing hypotheses were tested: 1) alcohol availability hypothesis, 2) the “power drinking” hypothesis and 3) the temporal shift in drinking hypothesis.

This study used a quasi-experimental comparison time series design. The analysed data sets are total and alcohol-related traffic fatalities and injuries for Ontario, for the 11-12 pm, 12-1 am, 1-2 am and 2-3 am time windows, for 4 years pre- and 3 years post-policy change, compared to neighbouring regions New York and Michigan. The findings suggest a possible small effect post policy change.

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Introduction

Over the past decade, the number of deaths and injuries related to impaired driving has decreased significantly in Canada and the United States as well as in other industrialized nations (Stewart, Voas & Fell, 1995; Sweedler, 2002). However, this progress to reduce the consequences of impaired driving may have come to an end. Recent statistics have shown that the downward trend has plateaued and possibly reversed in many jurisdictions (Insurance Institute for Highway Safety, 2003; Mayhew et al., 2002; Stewart & Fell, 2002; Sweedler, 2002).

The progress that has been made to reduce impaired driving however, is being challenged by a political and economic mood against governmental control and regulation (Anglin et al., 2002; Gliksman et al., 1995; Stewart, 1996). Moves to privatization, de-regulation, liberalization and fewer controls have been evident internationally (Vingilis, et al., 1998). One example of liberalization occurred in the province of Ontario with the extension of drinking hours in licensed establishments. On May 1, 1996, Ontario, Canada amended the Liquor Licence Act to extend the hours of alcohol sales and service in licensed establishments from 1 to 2 am. This amendment change provided an excellent natural experiment to evaluate an important alcohol policy.

Background

The relationship among physical availability of alcohol, alcohol consumption, and alcohol-related problems is multi-faceted and complex (Ashley & Rankin, 1988; Skog, 2003). Availability theory, simply stated, posits that alcohol availability influences consumption levels, which influence alcohol problem levels in a population. The availability theory approach to alcohol problems is predicated on the assumption that alcohol problems can be reduced by lowering the amount of alcohol consumed in society (Chikritzhs & Stockwell, 1997; Ragnarsdóttir et al., 2002; Rush, et al., 1986). Alcohol control policies are one such set of "health protection measures" that governments, agencies or industry can implement to reduce per capita consumption. This essentially occurs through the imposition of various "barriers" that control consumer-product interaction (Ashley & Rankin, 1988). However, it is important to point out that factors affecting aggregate alcohol consumption are strongly related to availability factors only when other conditions remain unchanged (Room et al., 2002; Skog, 1990, 2002).
As Room et al., (2002) write, “effects of smaller changes in availability seem more variable, and often negligible in terms of the effects on total consumption” (p.167). For example, Simpura (1995) has described the trends of alcohol consumption and has demonstrated that despite the fact that differences among European countries are still large, a “process of homogenization is slowly proceeding in the EU (European Union)”, whereby the consumption has been decreasing in high consuming countries and the reverse has been occurring in low consuming countries. He argues that homogenization amongst countries has been occurring not only as a consequence of economic or health policy but also as “a symbolic battlefield on new social and cultural order”. Thus, it is not surprising that evidence on the effectiveness of limitations on physical accessibility is mixed. For example, studies on density of outlets have generally found that fewer outlets per square mile or per capita are associated with less alcohol consumption and related problems (Gliksman & Rush, 1986; Gruenewald et al., 1993; Rush et al., 1986; Watts & Rabor, 1983), although Colon et al., (1982) found the opposite results and speculated that if alcohol outlets are farther apart, more crashes may occur because drivers travel farther to and from outlets. Others found that effects between density of alcohol outlets and drinking driving were more complex (Gruenewald et al., 1996; Gruenewald et al., 2002; Treno et al., 2003).

In addition to availability theory, “power drinking”, (also called “last call” or “six o’clock swill”) has been suggested as a countervailing hypothesis (Chikritzhs & Stockwell, 2002; Room, 1988; Ragnarsdóttir et al., 2002). This hypothesis suggests that tight restrictions on closing times lead to great numbers of drinkers consuming as much alcohol as possible at “last call” for the service of alcohol, shortly before the licensed establishment closes. This means increased blood alcohol concentrations of patrons as they imbibe large amounts of alcohol (power drinking) over a short time period. These crowds of patrons leaving licensed establishments at closing times then become involved in increased levels of intentional and unintentional injuries and other types of problems. This hypothesis has often been cited as evidence that closing hours of licensed establishments should be less restricted as a way to reduce alcohol-related problems (Chikritzhs & Stockwell, 2002; Ragnarsdóttir et al., 2002).

This was the rationale advocated by the Ontario government for extending the drinking hours. In 1993, the Ontario government consulted 10 stakeholder groups regarding extended drinking hours. All but three were opposed. Arguments in favour included: a) Ontario was the
only province which still had a 1:00 am stop-service time which encouraged inter-provincial and cross-border dining, putting Ontario licensees at a disadvantage, b) there would be less neighbourhood disruption as patron exodus from establishments would occur over a longer time period, c) less likelihood of patrons “loading up” on last call, and d) increased licensee revenues, while arguments against included fears of increased impaired driving, public drunkenness, later hour neighbourhood disruption, the requirement of increased police resources and lack of public transit past 1:30 am. (Liquor Licence Board of Ontario, 1995). Despite concerns, the newsletter of the provincial liquor licensing authority stated: "New regulations came into effect May 1, 1996, that update Ontario's liquor regulations to reflect today's attitudes" (The Liquor Licensing Board of Ontario, 1996).

Research on hours and days of sale is limited. It is noteworthy that no published North American studies have specifically evaluated this alcohol control measure. Yet, Smart (1980) has noted that legislators manipulate days and hours of sale more than almost any other control measure and various jurisdictions have recently reviewed extended drinking hours policies (e.g. Alcohol Health Watch, 1998; Institute of Alcohol Studies, 2002; Jang, 2002; Strategic Task Force on Alcohol, 2002). The studies that have been carried out have been conducted in Europe or Australia. One study investigated the closing of liquor retail stores on Saturdays and the remaining studies investigated the extension of days or hours of sale in licensed establishments.

Olsson and Wikstrom (1982) studied the effects of experimental Saturday closing of liquor retail stores in Sweden. A comparison of the data from the summer of 1980 with the summer of 1981, when the experimental legislation was introduced, showed that alcohol sales declined by 8%, the number of intoxicated persons detained, declined by 11%, and the number of police interventions for domestic disturbances by 15%. Data on impaired driving charges and alcohol-related crashes were not available.

A series of studies on the effects of increased hours of sale of alcoholic beverages in various cities and states of Australia have been reported by Smith. The increased days and hours were due to early openings (Smith, 1986), the introduction of Sunday alcohol sales in the cities of Perth and Brisbane (Smith, 1978, 1988a), and in the state of New South Wales (Smith, 1987), the extension of hotel closings from 6 pm to 10 pm in Victoria (Smith 1988b) and from two 2-hr sections on Sunday to an 8-hr section in Victoria (Smith, 1990), and the introduction of flexible
trading hours (which permitted hotels to stay open later than the previous 10 pm closing time in Tasmania (Smith 1988c). In all these instances, significant increases in either fatal or injury-producing crashes were observed in the years in which alcohol became more available in comparison with previous years, control times periods or control areas where no changes were introduced. However, a number of methodological and statistical problems preclude firm conclusions being drawn from these studies. For example, no information was available on BACs of drivers involved in crashes. The increased crashes could simply be due to more people on the road, rather than to impaired driving. In addition, the author had to contend with a number of confounders, such as the simultaneous introduction of other alcohol control policies such as the reduction of the maximum blood alcohol level (BAL) from .08% to .05%, and the extending of evening hours drinking and Sunday drinking. Moreover, the data were subjected to simple pre-post Chi² tests, which are subject to internal validity threats such as history effects (Posavac & Carey, 1997).

More recently evaluations of the public health and safety impact of extended trading permit hours were conducted in Perth, Australia (Chikritzhs, Stockwell & Masters, 1997; Chikritzhs & Stockwell, 2002). The extended trading permit hours were granted to some but not all applicants. The permit allowed an additional hour of serving alcohol, typically at peak times, such as the early Saturday or Sunday. Chikritzhs et al., (1997) conducted a study of 20 pairs of hotels matched on levels of assault prior to the introduction of late trading and wholesale purchase of alcohol in Perth between 1991-1995. Half of the hotels received extended drinking hours permits in 1993-4. Levels of monthly assaults more than doubled in hotels that had received extended hours permits compared to no changes in hotels with normal hours. However, no significant increases in road crashes were found related to the extended trading permits. A subsequent evaluation (Chikritzhs & Stockwell, 2002) examined the impact of extended trading hours on levels of violent assaults on or near licensed establishments between 1991 and 1997. A linear regression of the monthly time series was used to test the relationship between extended trading and monthly assaults associated with hotels with extended trading permits while controlling for assault rates among hotels with normal 12:00 am closing hours. They found significant increases in monthly assault rates for hotels with extended trading permits after the introduction of extended trading hours. This relationship was mostly accounted for by increased
volumes of alcohol purchase by late trading hotels. However, changes in motor vehicle collisions were not studied.

Two studies were conducted in Scotland to evaluate the effects of changes in liquor licensing arrangements. These were introduced in 1976-77 and included the extension of drinking in public bars from 10 pm to 11 pm, Sunday bar openings and the addition of "all day licenses" which were regular extensions of permitted hours. Duffy and Plant (1986) plotted relative risk time series from 1970 to 1985 for mortality from liver cirrhosis, from alcohol dependence and total alcohol related mortality, hospital admissions for alcohol dependence, drunkenness and drink-driving convictions but did not subject them to any statistical analyses. The authors report that "the study showed no appreciable effect on the level of alcohol-related morbidity and mortality, although some improvements were noted in relation to the rates of convictions for drunkenness" (p.36). Evaluating the same liberalization of the liquor licensing laws, Northridge, McMurray and Lawson (1986) collected data prospectively on 2868 consecutive patients admitted for self-poisoning (drug overdoses) between 1971 and 1982. Their analyses showed significant increases in the frequency of alcohol taken in association with self-poisoning with the relaxation of the liquor licensing laws. However, the lack of comparison groups and time series analyses precludes firm conclusions being drawn from the findings.

A recent study of extended drinking hours was conducted in Reykjavik, Iceland (Ragnarsdóttir et al., 2002). Until 1999, drinking hours in licensed establishments ended at 2 am on weekends and 11:30 on weekdays. However, the crowds of people leaving licensed establishments at closing time created congestion and other problems like injuries due to falls or assaults. In 1998, the Icelandic alcohol law was revised to allow unrestricted alcohol serving hours to reduce these problems. The evaluation consisted of; 1) police statistics, 2) telephone survey of all 33 proprietors of licensed establishments, 3) interviews with representatives of city centre inhabitants, street sweepers, restaurant inspectors and night life participants and 4) two field visits. The evaluation was conducted during eight weekends of March-April in 1999 and compared with eight weekends of March-April 2000. The results indicated pre-post increase of 14% in city centre police calls compared to overall police call increase of 6%. Admission to the emergency ward increased by 20% for the weekends but decreased by 2% for week days; intentional and unintentional injuries to the emergency ward also increased by 34% and 23%,
respectively. According to police reports, the number of cases of suspected drunk driving increased by 80%. However, the authors note the time, statistical and methodological limitations, but suggest that the data give rise to further questions regarding the impact of extended drinking hours.

Because of the methodological and statistical limitations of the studies cited above, we have limited information on the road safety impact of extended drinking hours in licensed establishments. Furthermore, because of the age of many of these studies and the cultural differences among these countries and North America, (for example, the unique system of distribution of alcohol in licensed establishments of on-premise and off-premise trading that exists in Australian jurisdictions) the generalizability of the results is difficult to assess.

Only one preliminary assessment has been conducted of Ontario’s new amendment. In August, 1996, four months after the law came into effect, the former Liquor Licence Board of Ontario (LLBO) (now amalgamated into the Alcohol and Gaming Commission of Ontario) surveyed their inspectors throughout Ontario to determine extent and number of violations against the new regulations on cease sale of service at 2 am complaints regarding after-hours sale and service since extension, increases in police services (number of after-hours violations since extension), the operating hours in district, and perceptions of problems, significant differences in operating style, violations, etc, (Bolton, 1996). The results of the survey were consistent across the province. No major increases in problems with the extended hours were documented. In fact, in the period from May 1, 1995 to Aug 1, 1995, when the 1 am closing was still in effect, police services reported to the Board 15 offences of Sale and Service of Liquor Outside Prescribed Hours (SSLOPH) and 38 violations of Fail to Remove Signs of Sale and Service (FRSSS) by 1:45 am. However, during this same period in 1996, only 3 breaches of SSLOPH and 5 offences of FRSSS by 2:45 am were reported, which constituted a reduction from previous year of 80% and 88%, respectively (Bolton, 1996). Perceptions of inspectors of changes in drinking patterns were that some establishments had increased sales while other establishments stated sales were the same because patrons were arriving and leaving later. Inspectors also indicated that many licensed establishments in their local areas that had historically stayed open until 1 am had extended their drinking hours to 2 am on Thursday to Saturday nights, but still maintained their 1 am closing on weekday nights of Sunday to Wednesday. However, the research design and
methodological problems of this study preclude conclusions being drawn about the impact of the new regulations. The purpose of this study was to conduct a comprehensive evaluation of the road safety impact of the extended drinking hours regulation in Ontario.

**Hypotheses of Impact of Extended Drinking Hours in Ontario**

The generic causal model for assessing the impact of extended drinking hours is presented in Figure 1. Within this causal model, three competing hypotheses were tested: 1) availability theory, 2) power drinking hypothesis and 3) temporal shift in drinking patterns hypothesis. Specifically, 1) *Availability theory* predicts that an extended drinking hour would increase alcohol consumption and lead to an overall increase in alcohol-related motor vehicle casualties. Evening road casualties should increase and shift by one hour; 2) The “*power drinking*” hypothesis posits that the former 1 am closing encouraged “loading up on the last call”. This led to a large number of impaired patrons driving after the establishment closed. The government advocated the extension of drinking hours as a way of extending the same quantity of drinking over an extra hour, thereby reducing the 1 am exodus of patrons from licensed establishments. This hypothesis would thus predict an overall decrease in alcohol-related motor vehicle casualties; 3) The *temporal shift in drinking pattern hypothesis* arose from the preliminary survey conducted by the LLBO (Bolton, 1996). This hypothesis posits that the amount of consumption will stay the same because patrons will stay at licensed establishments the same length of time. Rather patrons will shift their hours of patronage; for example, they will arrive one hour later and leave one hour later, as suggested by the LLBO survey. This should lead to a temporal shift in alcohol-related motor vehicle casualties, but no overall increase.

**Conceptual Framework**

This study used a multi-methods, multiple-measures elaboration design, which starts with a simple design and adds to it specific features to help control for specific sources of invalidity not controlled for in the initial design format (Bernstein & Sheldon, 1983). Each step of the causal model depicted in Figure 1 was assessed which included both process and outcome measures (Posavac & Carey, 1997; Rossi, Freeman & Lipsey 1999; Weiss, 1998).

The purpose of the process evaluation was to measure the extent to which the new regulation had been implemented. Gathering of contextual (process) information on the implementation of the new policy and the policy environment is important to evaluation, as
without these data the evaluator will be unable to distinguish between lack of policy impact and inadequacies in implementation (Vingilis & Burkell, 1996; Vingilis & Pederson, 2002; Weiss, 1998). The process component of the evaluation consisted of a survey of licensed establishments in Ontario in order to determine what percentage of establishments had taken advantage of the extended drinking hours and to obtain perceptions of proprietors of licensed establishments.

Evaluation research is further enhanced through the use of intermediate outcomes within the causal model (Mayne, 2001; Vingilis & Pederson, 2002; Weiss, 1998) to increase convergent validity (Cook & Campbell, 1979). The intermediate outcome component, alcohol consumption, was not possible to measure. Alcohol sales for licensed establishments by hour of sales are not kept beyond six months. Thus retrospective alcohol sales specifically for licensed establishments by hour of sales were not available. However, overall trends in volume of sales of alcoholic beverages in Ontario were assessed, although it is realized that this measure 1) includes both personal and licensed establishment purchases and 2) cannot be equated to total consumption of alcoholic beverages. This crude measure cannot provide us with direct alcohol consumption information related to the impact of extended drinking hours, but it can provide information on overall trends in purchase of alcohol in Ontario during the evaluation time period.

The criterion outcome indicator was motor vehicle fatalities. A quasi-experimental design using interrupted time series with a nonequivalent no-intervention control group was used to assess changes in total and BAC+ motor vehicle fatalities with the introduction of the extended drinking hours regulations.

Methods
Survey of Licensed Establishments

The questionnaire was developed in collaboration with consultants to this study. The questionnaire contained eight open- and closed-ended questions focussing on licensing information, type of establishment, current hours of business, whether and how the establishment changed hours since the LLBO amendment, and perceptions of changes to business, attendance, patrons’ behaviours and operating costs. The survey was pre-tested and changes were incorporated into the final version. The study received ethical approval from the Ethics Review Board of the University of Western Ontario. The LLBO provided their current list of all 16,4666
licensed establishments in Ontario. A 10% random sample of licensed establishments was computer generated and using a modified Dillman method (Dillman, 1978) for questionnaire dissemination and follow-up procedures, an anonymous mail-in survey with covering letter and a return University of Western Ontario addressed and stamped envelope was sent to a sample of 1,647 licensed establishments on January 5, 2000. Anonymity and confidentiality was assured to the participants and only the principal investigator and project coordinator had access to the questionnaires. A reminder postcard was mailed out three weeks after the first mailing and additional questionnaires if requested. Of the 1,647 surveys that were mailed out, 244 questionnaires were returned for a response rate of 16.0%. However, it is important to point out that although we received the most current LLBO listing of licensed establishments we did not know how many were in fact were no longer in business at the time of the mailing, as 126 surveys and/or reminder cards were returned by the post office as address unknown.

Volume of Sales of Alcoholic Beverages

In Ontario, the purchase on any alcohol (wine, beer and spirits) used in licensed establishments or for "personal" consumption is through government regulated monopoly stores with the exceptions of duty free and possible contraband purchases (Girling, 1994). Additionally, alcohol prices are government controlled so the prices of different brands remain the same throughout the province. Data were available on yearly sales in litres to licensees and to retail for domestic and imported wines, beers and spirits for Ontario for the years April 1,1989 to March 31,1999 (Statistics Canada, 2000).

Motor Vehicle Fatalities

The focus of this study was on the total fatalities and BAC+ fatalities during the 11 pm to 4 am time windows. Additionally, these data were disaggregated by day of week. A post policy survey by the LLBO found that licensed establishments in smaller communities often maintained their 1 am closing for Sunday through Wednesday nights because of lack of sufficient business, but kept open until 2 am on Thursday through Saturday nights (Bolton, 1996). Thus, the data were collapsed into two weekday groups; 1) Sun-Wed nights (Sunday 11 pm to Thursday 4 am), and 2) Thurs-Sat nights (Thursday 11 pm to Sunday 4 am). The criterion data sets for the evaluation are monthly motor vehicle casualties for the 11-11:59 pm (denoted as 11 p.m-12 am), 12-12:59 am (12-1 am), 1-1:59 am (1-2 am), 2-2:59 am (2-3 am), and 3-3:59 am (3-4 am) time
windows, by weekday grouping (Sun-Wed vs. Thurs-Sat) for 4 years pre- and 3 years post-policy change in Ontario compared to New York and Michigan, two neighbouring American states. The neighbouring US states of New York and Michigan were chosen as comparator regions to control for climatic and history effects (Cook & Campbell, 1979) and because the neighbouring province of Manitoba did not have enough collisions. We need to get updated figures for these... if we can find 1996 figures for everything - the year of the amendment or any more recent than 1994. Measures of indices of alcohol consumption, relative importance of alcohol by sector and per capita consumption for Canada and the United States indicate very similar patterns and trends (Produktschap voor Gedistilleerde Dranken, 1994; Williams, Chang & Van Truong, 1994). In addition, the trends for both the United States and Canada, including Ontario have been showing a downward trend in per capita consumption and alcohol-related health and safety consequences since the 1980's (Anglin, Mann & Smart, 1995; Mann & Anglin, 1988; Mann et al., 1991; Smart & Mann, 1987; Produktschap voor Gedistilleerde Dranken, 1994). Similarly, motor vehicle fatality and drinking-driving fatality data are comparable despite the differences in data gathering and definitions (need updated ref Ministry of Transportation of Ontario, (MTO) 1992; NHTSA, 1992). For example, 70% of Ontarians are licensed drivers compared to 67% of Americans. Furthermore, despite the somewhat different classifications and rates of testing, both Ontario and the U.S. have virtually identical breakdowns of drinking-driver fatalities with 59% at zero BAC, 7% at .01-.09 BAC and 34% at .10 and higher BAC. Again, similar trends for drinking-driver fatalities have been evident in both countries during the 1980's and 1990's. (need updated ref. MTO, 1992; NHTSA, 1992). Licensed establishment closing hours for are from 1 am to 4 am for New York, depending on the county, and 2 am for Michigan.

Two datasets used were: 1) Traffic Injury Research Foundation (TIRF) and 2) the US Fatal Accident Reporting System (FARS) databases. The TIRF fatality database is a comprehensive source of objective data on alcohol use among persons fatally injured in motor vehicle crashes occurring on and off the highways (eg. snowmobiles, boats, pedestrians). It includes: characteristics of drivers, passengers, and pedestrians; details of the crash (eg. type of collision, date, time); and type of vehicle(s) involved. Objective information on the presence
and quantity of alcohol (concentrations detected by chemical tests on blood, urine or other body fluids) as well as information needed to interpret the results of chemical tests - such as time of death - are key features of the TIRF database. Two sources of information provide data for most case files; 1) police-reported data on fatal motor vehicle collisions and 2) files in the offices of coroners and medical examiners. Because of the high BAC testing rates of over 80% for Ontario drivers fatally injured within six hours of collision, this database provided the most sensitive measure of changes in alcohol-related fatalities. In 1996, 37% of fatally injured drivers were BAC+ and of those 30% were over Canada’s legal limit of .08%.

The FARS database on police-reported fatal motor vehicle collisions is gathered from states owned source documents and are coded on standard FARS forms. In order to be included in FARS, a crash must involve a motor vehicle travelling on a traffic way customarily open to the public and result in the death of a person (either vehicle occupant or non-motorist) within 30 days of the crash. Nationwide in 1996 a total of 16,689 fatally injured drivers had BAC test results out of 24,456 or 68.2%. Testing rates for Michigan and New York, the two comparison states, were 71.2% and 47.8%, respectively. In Michigan for 1996, 1505 drivers died of whom 41% were BAC+ and 32% were over .10%, while in New York, 1564 drivers died of whom 34% were BAC+ and 24% were over .10%. Although there are differences in the definitions of driver fatality between the TIRF and FARS databases (6 hrs vs 30 days from crash) we were interested in contrasting the overall trends among the two databases.

**Statistical Analyses**

Data from the licensed establishment surveys were entered into SPSS data editor, checked and cleaned and frequencies were generated. The time series data were converted into tab-delimited ASCII files using Perl, inputted to S-Plus and were subjected the following analyses.

**Ian can you provide a couple of paragraphs to generally describe the statistical analytical approach, i.e. what was done statistically? E.g** First, data visualization was used (Cleveland; 1993), which consists of two steps applied iteratively: Step 1, fitting a model structure and then Step 2, using suitable graphical methods to show the model and the data after adjusting for the model. After Step 2, we were able to determine if the assumptions made in Step 1 were satisfied or not and were able to modify the model and repeat Steps 1 and 2. Visualization methods were
used to summarize and communicate the essential findings of our study. When appropriate these methods were supplemented by parametric statistical inferences such as confidence intervals on parameters in the model and attained significance levels of statistical tests.

Statistical Models....

**Results**

**Survey of Licensed Establishments**

Unfortunately, the response rate for the survey was low. We could not assess how representative the sample was compared to the population of licensed establishments in Ontario and therefore, the generalizability of the data are unknown. Of the licensed establishment respondents, 78.4% of the businesses were first opened before 1995, 60.7% listed themselves as bar/taverns or restaurant/bar and grill, (17% classified themselves as only bars or taverns), while the remainder included sports clubs, private/country clubs/legion, hotel/resorts, banquet hall/service clubs, nursing homes, race tracks, curling arenas and convention centres. In terms of hours of closing, what is noteworthy is the variation in closing times. Table 1 presents reported closing times of surveyed licensed establishments. As can be noted, licensed establishments are most likely to close at 2 am on Thursday through Saturday nights, while 1 am is more common on Sunday through Wednesday nights.

Of this group, 49.56% of respondents indicated that they had changed their hours since the LLBO amendment to the extended hour. Of those who changed their hours, 31.7% indicated that their closing hours shifted from 1 to 2 am for all days of the week, 26.6% indicated that their closing hours shifted from 1 to 2 am for Thursday through Saturday only, and 41.59% changed their hours in other ways, such as shifting of hours, shorter hours, and various combinations of openings throughout the whole week.

Establishments were asked how they have changed as a result of the change in hours of business. Specifically, 67.7% reported no change in liquor sales, 15.2% reported increases/great increases and 17.2% reported decreases/great decreases; 71.7% reported no change in food sales, while 9.8% reported increases/great increases and 18.4% reported decreases/great decreases; 64.6% reported no changes in attendance while 14.6% reported increased/greatly increased
attendance and 20.9% reported decreased/greatly decreased attendance; 12.0% reported that patrons’ unruly behaviour had increased/greatly increased, 66.3% indicated that it had remained the same and 21.8% said it decreased/greatly decreased; 51.0% stated that operating costs had increased/greatly increased, 43.9% that it stayed the same and 5.1% that it had decreased/greatly decreased.

Respondents were also asked about advantages and disadvantages of the extended drinking hours; 62.7% provided advantages (good for shift workers, opportunity for more business, appeal to tourists from other areas) while 55.7% responded with disadvantages (people consume too much alcohol, increase in staff costs, people going out later/stay home longer).

**Volume of Sales of Alcoholic Beverages**

Figure 2 presents the volume of sales in thousands of litres for beer, wine and spirits for Ontario between 1989 and 1999. The trends indicate that the consumption of beer has decreased between 1994 and 1998, while the consumption of wine and spirits decreased in the early 1990's and increased in the late 1990's. (Jane for the alcohol sales from Ian’s data, I would like to have the middle figure beerltr, etc as one graph.. I wonder if we can make them horizontally rather than vertically)

**Motor Vehicle Fatalities**

TIRF data on driver fatalities were available for Ontario from January 1, 1992 to December 31, 1998 and were aggregated to a monthly level for a total of 84 consecutive observations. Ten time series were created from the TIRF data set corresponding the two week group variables Sun-Wed (Sunday to Wednesday evenings), and Thurs-Sat (Thursday to Saturday evenings) and the five one hour time periods beginning at 11 pm, 12 am, 1 am, 2 am and 3 am. These are depicted as S11 (i.e., Sunday to Wednesday 11-11:59 am), S12, S1, S2, S3 and T11 (i.e., Thursday to Saturday 11-11:59 am) T12, T1, T2, T3. Separate analyses were conducted for total driver fatalities and BAC+driver fatalities. The focus of the analyses was on whether a change occurred after the introduction of the extended drinking hours, affective May 1, 1996, the 53rd observation.

FARS time series comprise the monthly number of driver fatalities for May 1, 1992 to December 31, 1999 for a total of 91 consecutive observations. Similarly ten time series were created. Separate analyses were conducted for total driver fatalities and BAC+ driver fatalities,
although it is important to note that in 38% of the records the BAC variable was missing. The focus of the analyses was on whether a change occurred concurrent with the introduction of the extended drinking hours in Ontario, affective May 1, 1996, the 49th observation.

Figure 3 presents the time series intervention analyses for the TIRF and FARS total driver fatalities. In Ontario (TIRF data) there were two significant post-intervention downward trends for Sun-Wed for the 12-1 and 1-2 am time periods and one almost significant upward trend for the Thurs-Sat 3-4 am time period. No other trends were significant. In New York and Michigan (FARS data), no significant trends were identified coincident with the Ontario extended drinking hours intervention.

Figure 4 provides the time series analyses for the TIRF and FARS BAC+ driver fatalities. The TIRF BAC+ data showed significant or non-significant downward trends for Sun-Wed 12-1 am, Sun-Wed 1-2 am and Thurs-Sat 11 pm -12 am time periods, but no other trends. On the other hand, the FARS BAC+ driver fatalities indicated significant or non-significant downward trends for Thurs-Sat 11 pm -12 am, 12-1 am, 2-3 am and 3-4 am but no changes for any of the other time periods following the Ontario policy change for any time periods.

In order to explore further the hypotheses, additional analyses were undertaken. To test availability theory, total and BAC+ TIRF and FARS driver fatality data were aggregated over the 11 pm- 4 am time period to determine whether there had been overall increases in BAC+ driver fatalities over the evening drinking hours. The results of the step intervention indicated no significant changes for Sun-Wed and Thurs-Sat groups for total driver fatalities for both TIRF and FARS. For BAC+ driver fatalities shown in Figure 5, downward trends were observed for Ontario TIRF data for both Sun-Wed and Thurs-Sat groups, while a significant downward trend was observed for the control group FARS data for the Thurs-Sat group. Thus no overall increases in BAC+ fatalities were observed for the TIRF data in support of availability theory.

To test between the power drinking and temporal shift hypotheses, two additional analyses were conducted. First, to control for possible overall downward trends in Ontario collision rates, the BAC+ TIRF driver fatality data were re-analyzed using the TIRF BAC- data as a covariate. The trends did not differ from the analyses without the covariate. I think we also way back modelled the graduated licence effect in 1994? Does anyone remember this?

Second, to determine whether there was a temporal shift in BAC+ driver fatalities, BAC+
TIRF data were collapsed over the pre- and post-amendment time periods for the different hours and Sun-Wed and Thurs-Sat week groups. Figure 6 indicates that for the Sun-Wed time period the peaks for alcohol-related driver fatalities occurred between 12 and 2 am pre-amendment while the peaks occurred between 2 and 4 post-amendment. However, the distribution changes for the Thurs-Sat time periods. Pre-amendment the peaks of alcohol-related driver fatalities occur at 11 pm - 12 am and 1-2 am while at post-amendment the distribution has flattened over the different time periods.

Discussion

These findings seem to support the contention of Room et al., (2002) and (Skog, 1990, 2002) that the effects of smaller changes in availability seem more variable, and often negligible. In Ontario the drinking in licensed establishments was extended for only one hour and thus possible effects on motor vehicle fatalities were expected to be small. Multiple measures were gathered to enhance validity by seeking convergence of findings, thereby enhancing the interpretability of findings.

The multiple datasets converge in support of the power drinking or temporal shift hypotheses. Availability theory was not supported because no increases in BAC+ driver fatalities were observed in Ontario after the amendment to extend drinking hours. Even controlling for overall trends in BAC- driver fatalities, the trends for BAC+ driver fatalities remained the same. However the data obtained from the survey of licensed establishments indicated that many licensed establishments did not avail themselves of the extended drinking hours and indeed the hours of closing was quite variable among licensed establishments across Ontario. For example, of the 17% of licensed establishments most likely to stay open late, bars and taverns, two thirds remained open until 2 am on Thursday and somewhat over four fifths stayed open until 2 am on Friday and Saturday. Other types of licensed establishments were much less likely to stay open until 2 am. This would suggest that alcohol availability was not substantively increased. Other factors may have determined for licensed establishments their hours of operation as indicated by the lists of disadvantages to the extended drinking hours amendment identified by survey respondents.

BAC+ driver fatality trends reflected downward trends for Sun-Wed 12-2 am and Thurs-Sat 1-2am for Ontario, and downward trends for Thurs-Sat 11 pm -1 am and 2-4 am for New
York and Michigan, suggesting diverging patterns between the extended drinking hours jurisdiction of Ontario and the control jurisdictions of New York and Michigan. However, the trends between total driver fatalities and BAC+ driver fatalities for Ontario were not divergent. If New York and Michigan is to be considered the counterfactual, the lack of concomitant significant reductions in Ontario could suggest that the extended drinking hours moderated the expected downward trend. However, there are lower BAC testing rates for New York and Michigan. This issue makes it difficult to assume that the New York and Michigan data are an ideal counterfactual. Ontario total driver fatalities may be a more appropriate measure of the counterfactual.

Moreover, a visual inspection of the pre- and post-amendment distribution curves for BAC+ driver fatalities for Ontario in Figure 6 suggest that two different phenomena may be occurring for Sun-Wed and Thurs-Sat nights. For Sun-Wed nights, the pre-amendment 12-2 am peaks for BAC+ driver fatalities seems to have shifted to 2-4 am post-amendment, while for Thurs-Sat the 11 pm -12 am and 1-2 am pre-amendment peaks seem to have decreased and flattened out over the 11 pm - 4 am time periods. These different distributions could suggest different patterns of drinking for week days and weekends by patrons of licensed establishments. It could well be that problem drinkers are more likely to engage in weekday evening drinking, while social drinkers are more likely to go out on weekends, although these speculations move beyond the scope of this paper. However, the Sun-Wed shifting of peak BAC+ driver fatalities could support the temporal shift hypothesis while the Thurs-Sat reduction and flattening out of the BAC+ driver fatality distribution could support the power drinking hypothesis, that would predict an overall decrease in alcohol-related motor vehicle casualties that seems to have occurred. Furthermore, the alcohol sales data found decreases in beer sales, the most commonly sold beverage in taverns and bars, (we need to check this and get reference) although increases in wine and spirit sales concomitant with the extended drinking hours amendment during the latter half of the 1990's. However, the survey of licenced establishments found that almost two thirds of respondents observed no increases in alcohol sales since the drinking hours had been extended. Thus, although it is not possible to choose between the power drinking or temporal shift hypothesis, it is clear that the different datasets converge to suggest that the road safety impact of smaller changes in availability was negligible in Ontario as a whole.
In summary it is important to point out that the limitations of the study may also have masked any significant findings. The fact that many licensed establishments did not change their hours of closing meant that alcohol availability may not have increased dramatically. The inability to disaggregate Ontario alcohol sales by licenced establishments and by hour of sales meant that we could not obtain verification of the survey findings that the majority of respondents perceived no changes in alcohol sales. Additionally, the limited number of BAC+ driver fatalities by hour of day and the rarity of motor vehicle fatalities may have made this dataset too insensitive a measure to detect changes. Finally, alcohol-related problems may be localized in areas where there are many bars and taverns as was found in the Ragnarsdóttir et al., (2002) study of downtown Reykjavík, Iceland. Further research using other measures of alcohol-related problems, such as assaults and in more localized regions of high densities of licensed establishments may provide more sensitive measures of the impact of extended drinking hours.

These results, however, are consistent with the international literature. For example, Chikritzhs et al., (1997) found no significant increases in road crashes related to the extended trading permits, although they did find differences in levels of violent assaults on or near licensed establishments. To summarize, these findings support international research that increases in alcohol availability affect aggregate alcohol consumption and alcohol-related problems only when other conditions remain unchanged (Room et al., 2002; Skog, 1990, 2002). The small change in policy, the limited implementation and other societal factors such as economic conditions and road safety countermeasures may have mitigated any affect on alcohol-related motor vehicle fatalities in Ontario.
References

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Table 1  % Reported Closing Times of Licensed Establishments from 8 p.m. to 2 a.m.

<table>
<thead>
<tr>
<th>Weekday</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>1</th>
<th>2</th>
<th>Total</th>
<th>N</th>
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<tbody>
<tr>
<td>Monday</td>
<td>4</td>
<td>7.5</td>
<td>11.1</td>
<td>11.1</td>
<td>10.6</td>
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<tr>
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<td>7.1</td>
<td>10.0</td>
<td>11.4</td>
<td>11.0</td>
<td>24.8</td>
<td>16.2</td>
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<tr>
<td>Wednesday</td>
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<td>8.9</td>
<td>10.7</td>
<td>11.7</td>
<td>9.8</td>
<td>25.2</td>
<td>16.4</td>
<td>85.5</td>
<td>214</td>
</tr>
<tr>
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<td>7.9</td>
<td>10.2</td>
<td>11.6</td>
<td>9.3</td>
<td>20.4</td>
<td>22.7</td>
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</tr>
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<td>Friday</td>
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<td>5.5</td>
<td>6.8</td>
<td>10.5</td>
<td>6.4</td>
<td>21.5</td>
<td>32.0</td>
<td>85.9</td>
<td>219</td>
</tr>
<tr>
<td>Saturday</td>
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<td>6.0</td>
<td>6.0</td>
<td>10.2</td>
<td>6.5</td>
<td>21.4</td>
<td>32.6</td>
<td>86.4</td>
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<tr>
<td>Sunday</td>
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<td>10.8</td>
<td>11.9</td>
<td>17.6</td>
<td>9.1</td>
<td>11.4</td>
<td>14.2</td>
<td>81.8</td>
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</tbody>
</table>
Figure 1

New Policy —> Licensed Establishments Extending Drinking Hours —> Changes in Consumption —> Changes in Motor Vehicle Casualties
Figure 2 Annual Volume of Sales of Beer, Wine and Spirits for Ontario 1989-1999

Consumption of Spirits, Wine and Beer

litr and abs are in millions of litres, perc are percentage
Figure 3: Total Monthly Driver Fatalities by Week Group and Time of Night

Ontario Total Fatalities

New York and Michigan Total Fatalities

S=Sun-Wed; T=Thurs-Sat; 11=11 pm-11:59 pm, 12=12 am-12:59 am, . . .

p=.132

p=.044

p=.006

p=.103

p=0.88

Figure 4: Total Monthly BAC+ Driver Fatalities by Week Group and Time of Night
Figure 4: Total Monthly BAC+ Driver Fatalities by Week Group and Time of Night

Ontario Total BAC+ Driver Fatalities

Michigan and New York Total BAC+ Driver Fatalities

p=.08

p=.024

p=.03

p=.014

p=.11

p=.001

p=.06

S=Sun-Wed; T=Thurs-Sat; 11=11pm-11:59 pm, 12=12 am-12:59 am, . . .
Figure 5 Total Monthly BAC+ Driver Fatalities by Week Group Aggregated Over Late-Night Hours

TIRF Fatalities BAC Positive, Aggregated over Late-night hours.

FARS (MI & NY) Fatalities BAC Positive, Aggregated over Late-night hours.
Figure 6  BAC+ Driver Fatalities by Time of Night and Week Group Before and After the Amendment

Before and After

Pre-Amendment?

Post-Amendment?

Before and After

Before and After