



Long and Short- Term Evaluation of Voluntary Travel Behaviour Interventions

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Background

- **Voluntary travel behaviour change is currently a popular strategy**
- **Subject to evaluation to ascertain what reductions in car use have occurred**
- **Desire to measure benefit-cost ratios, for it**



Fundamentals of VTBC

- **Voluntary** because nothing is changed in the transport system
- **Changes are made because the individuals choose to do so for personal reward**
 - No top-down mechanism or compulsion to change

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Fundamentals of VTBC

- Focuses on individual marketing or information provision
- Compared to almost all other transport strategies – extremely low cost
- Potential to reduce dependence on car and reduce greenhouse gas emissions



Hopes for VTBC

- **National Travel Behaviour Change Program**
 - Seeks to achieve 3,850 million VKT reduction by 2013
 - Expected reduction in CO₂ of more than 1.2 million tonnes
- Other programs aim at reducing car dependence and need for major capital works



How to Measure Change

- Actually a difficult process, especially when it is important to identify cause and effect
- Usually requires at least two surveys
 - Before
 - After
- May involve continuing, long-term monitoring



Type of Survey

- Repeated cross sections, or panel?
- Sample size issues:
 - Repeated cross sections require much larger samples
 - Difference in sample sizes shown on next slide

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Sample Size Requirements

- For a repeated cross-section:

$$n = \frac{s_1^2 + s_2^2}{(\text{s.e.}(\bar{x}_2 - \bar{x}_1))^2}$$

- For a panel survey:

$$n = \frac{s_1^2 + s_2^2 - 2R_{12}s_1s_2}{(\text{s.e.}(\bar{x}_2 - \bar{x}_1))^2}$$

- Last term is important because of its effect in reducing required sample size



Sample Size Requirements

- Even assuming a relatively modest correlation between the before and after panel samples, the sample size is reduced substantially
- Suppose we are looking at a population of 30,000 households where an intervention is to take place

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Sample Size Requirements

- **Suppose we expect a change of 10% in car driver kilometres over the entire population**
 - Suppose we wish to estimate the change with ± 2 percent accuracy at 95 percent confidence
- **Assume mean kilometres per day is about 40, with a standard deviation of 48 kms per day**
 - New average kms/day will be 36



Sample Size Requirements

- Assume that the standard deviation of the VKT after the intervention is 43 kms/day
- The required sampling error is ± 0.41 kms
- For a repeated cross-sectional sample, the required sample size is 25,223 households
 - Applying the finite population correction factor, this reduces to 13,702 of the 30,000 households



Sample Size Requirements

- Now, assume that we use a panel and that the correlation between the before and after surveys is 0.7
- The required sample size is now 7,516
 - Applying the FPCF, this reduces to 6,010
- Thus, the panel sample size is less than half of the repeated cross-section sample



Sample Size Requirements

- Repeated cross-section requires recruiting 27,404 households to complete the survey from a 30,000 population
- Panel requires recruiting 6,010 households from the same population

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Repeated Cross-Sectional Samples

- Repeated cross-sections are easier to do
 - No need to recruit households to repeat the survey task
 - Random drawing requires no tracking of households
- BUT...
 - High probability of recruiting the same household twice
 - Probability of much poorer response rate on the after survey
 - Doesn't lend itself to continuing monitoring



Using Panels

- Panels reveal dynamics of change
- Panels have a number of potential problems:
 - Attrition
 - Conditioning
 - Loss of representativeness over time
 - Effort needed to maintain panel member interest
 - May need incentives
- Nevertheless, advantages outweigh disadvantages
 - Uses far fewer households
 - Requires much less recruitment effort
 - Lends itself to continuing monitoring



Issues of Variability

- Travel behaviour varies substantially from day to day and week to week
- The longer the period of measurement, the less the variability
 - Daily variance may be around 1.2 times mean
 - Weekly may be around 0.4 times mean
- Two-day diaries and longer are problematic



Exogenous Changes

- Usually requires a control group
- Problems with selection of control groups
- Control groups need to be:
 - Demographically similar
 - Similarly located in the city
 - Similarly served by transport

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Measurement Error

- **Most evaluation to date relies on self-reporting**
 - Known to be erroneous
- **Methods that rely little on self reports likely to be better:**
 - Odometer surveys
 - GPS surveys

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Other Issues

- **Corroborative evidence should be acquired**
 - Public transport ridership
 - Road volume counts
 - Ticket sales
- **Diffusion effects**
 - Difficult to measure
 - Contamination of control groups
 - Contamination of panels



Short-Term Measurement

- All short-term measurement to date has relied on diaries
 - Most have been postal diaries
 - Probability that postal diaries seriously understate travel
 - This would be all right if underreporting is consistent
 - No evidence that this is so
 - Underreporting may be much more serious for short trips



Short-Term Measurement

- **Most short-term evaluations have used repeated cross sections**
 - Sample sizes have generally been in the range of 100 to 400 households
 - Results have suggested 4 to 14 percent reduction in car driver VKT

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Sampling Error

- Assuming the earlier figures:
 - s_1 is 48
 - s_2 is 43
 - And n is, say, 400
- What is the sampling error?
 - For repeated cross sections, this gives a sampling error of ± 3.22 kms
 - A 10 percent change in VKT is 4 kms
 - 95 percent confidence range is 4 ± 6.32 kms
 - I.e., we do not know if the change is even a reduction or an increase



Short-Term Measurement

- **Short-term measurement to date:**
 - Has relied on self-reported diaries
 - Known to underreport travel
 - Has used too small sample sizes to measure a change of even 10 percent
 - In fact, sampling error suggests we would have to measure a change of at least 16 percent to have confidence that there was a reduction



Short-Term Measurement

- Has generally not used control groups, or has paid relatively little attention to careful selection of control groups
- Has relied on one day of measurement which has inherently high variability
- Hence, short-term measurement to date has produced little certainty about the results



Long-Term Measurement

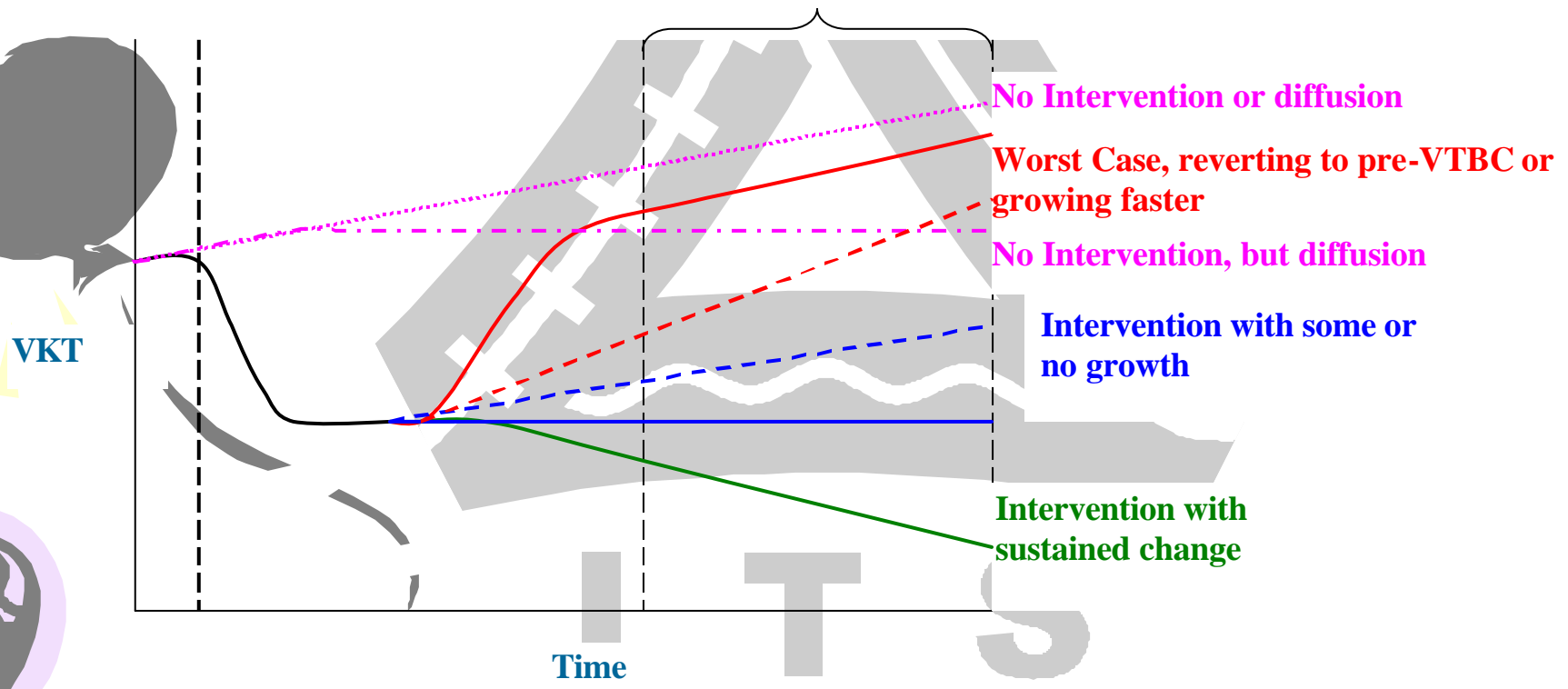
- **Poses more substantial difficulties**
 - What are we looking for in the long term?
 - What sample sizes do we need to establish what we are looking for?
 - What methods can be used?
 - How do we get people to respond over a long period of time?
 - At what level of geography do we wish to be able to report results?



What We Are Measuring

Point of Intervention

Period of long term monitoring





Sample Size Requirements

- Function of how long a measuring period and method of measurement
- Function of the acceptable level of error
 - Actual VKT growth over time is about 1 percent per annum
 - Do we need to detect if the growth rate is slower?



Methods

- **Issues for methods:**
 - Panel or repeated cross-section?
 - How long an observation period to use?
 - How long will people be willing to remain in a panel?
 - What method can be used to measure reliably?



Period of Monitoring

- Initial period of long-term monitoring is five years
 - Will people be willing to be measured repeatedly for five years?
 - If not, will we run out of sample in five years?
 - What about inherent population mobility?
 - What' about diffusion?



Exogenous Change

- In the long-term, this is a much more serious issue
 - Effects of changes in the national economy
 - Effect of changes in petrol prices
 - Effect of changes in bus fares, schedules, routes
 - Effect of structural changes in the household



Exogenous Change and Diffusion

- **Control groups will be harder to find**
 - More of the population of similar suburbs will have received intervention
 - Diffusion will further reduce available control populations
- **Without control groups, we cannot ascertain effects of exogenous changes**
 - Disaggregate analysis (household-by-household) is probably not possible



Long-Term and Short-Term Comparability

- **Methods used in the long- and short-term must produce compatible results**
 - If not, then it will be unknown how the long-term results relate to short-term results
- **Preferable to use the same methodology for both**



Potential Solutions

- Measurement methods need to be as low burden as possible
- Advantages of the panel are clear
 - Rotating panel may be best, to reduce panel conditioning and fatigue
- Sample size is still to be determined



Odometer Surveys

- Odometer surveys provide precise measurement of VKT
 - Quarterly odometer survey would permit estimating both daily average and total quarterly VKT
 - Measurement is low burden, but requires a method to remind households
 - Basic method would be to remind households with a postcard that allows recording of date and odometer readings



Odometer Surveys

- **Odometer Survey:**
 - Can use multiple methods:
 - Telephone
 - Post card return
 - E-mail or internet
 - Will require updating household characteristics each time
 - Quarterly measurement helps maintain a panel



Odometer Surveys

- **Results can be analysed:**
 - Quarter-by-quarter
 - Year-to-year
- **Rotating panel could remain for 2 or 3 years**
- **Restricted measurement to VKT**
 - No information on public transport, walk, or bicycle



Potential Solutions

- **GPS survey:**
 - New technologies are making more acceptable devices available
 - Small size and weight antenna/receiver
 - Possible form factors of mobile or watch
 - Increased memory capability – up to 1 gigabyte

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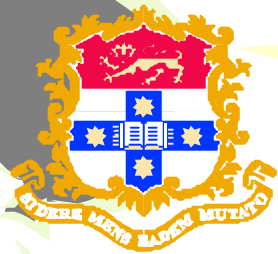
GPS

- **Could be used for a week or a month or longer**
 - Requires focus groups to find out acceptability
 - Functioning mobile or watch may be key
- **Could be used for an annual survey**
- **Still requires household data as for odometer survey**
 - Also requires information on household changes



GPS

- **Potential to measure all travel and to determine mode shifts**
- **Can be validated by odometer survey carried out in conjunction**
- **Acceptability with old technology has been shown to be higher than diary**



Exogenous Change

- Control groups may be infeasible, *per se*
- Should measure both participating and non-participating households
 - Could ascertain at the end of a household's participation knowledge of TravelSmart
- Cannot ascertain highly disaggregate results

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Exogenous Change

- **Best method is to determine trends in travel for as long before intervention as possible**
 - **Establish survey measurement a year or more in advance of intervention**
 - **Track both participating and non-participating households**

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Conclusion

- Requires use of the same methodology for short- and long-term monitoring
- Sample sizes may still need to be large – hundreds of households
- Combination of odometer and GPS appears very promising
- Rotating panel may be best design
- Measurement needs to be done for significant time periods
- Measurement needs to be established well before intervention and cover participating and non-participating households