Crime mobility polygons in three municipalities

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? , In transition between Newark to Texas State
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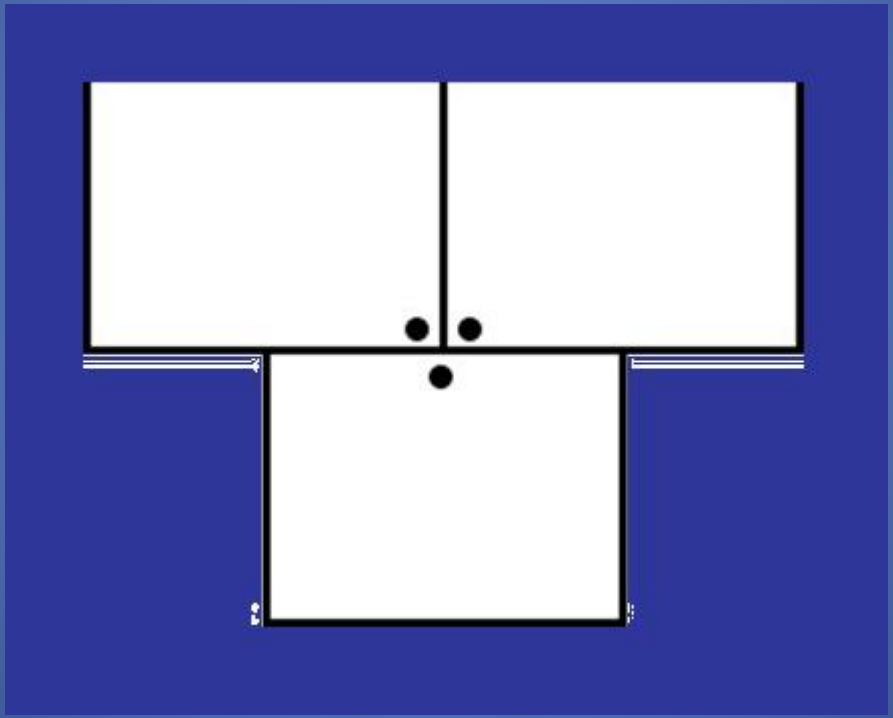
Mobility triangle invented by

Ernest W. Burgess 1925

"Can neighborhood work have a scientific basis?" In R.E. Park, E.W. Burgess, and R.D. McKenzie (Eds.), *The City: Suggestions for Investigation of Human Behaviors in the Urban Environment* (pp. 142 – 155). Chicago, IL: University of Chicago Press.

Burgess only applied mobility triangles to areas, which can understate proximity



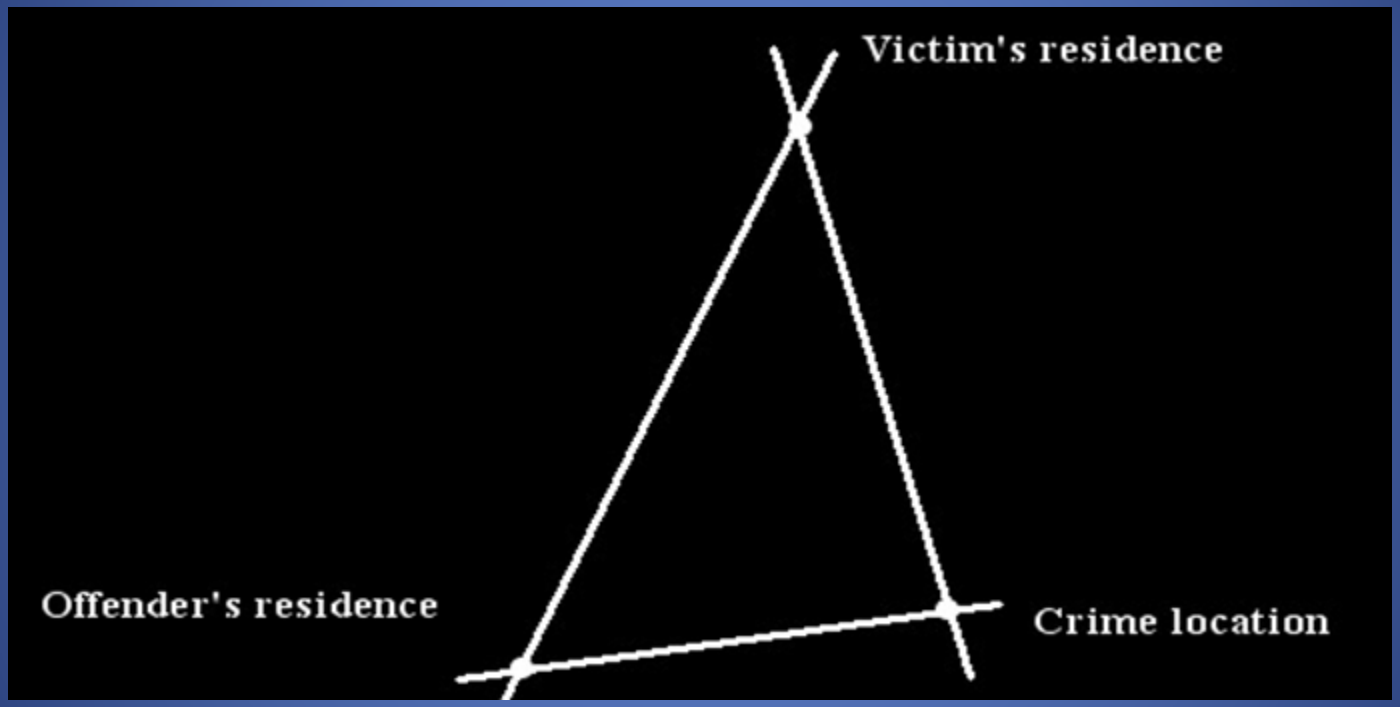
Mobility triangle perfected by

Liz Groff and Tom McEwen in a series of reports and papers, e.g.,

Groff, E.R. and T. McEwen (2007) Integrating distance into mobility triangle typologies. *Social Science Computer Review* 25: 210 – 238.

Specific locations on the map for offender, victim, crime location

Crime mobility triangle 21st Century – Modern data files make this work



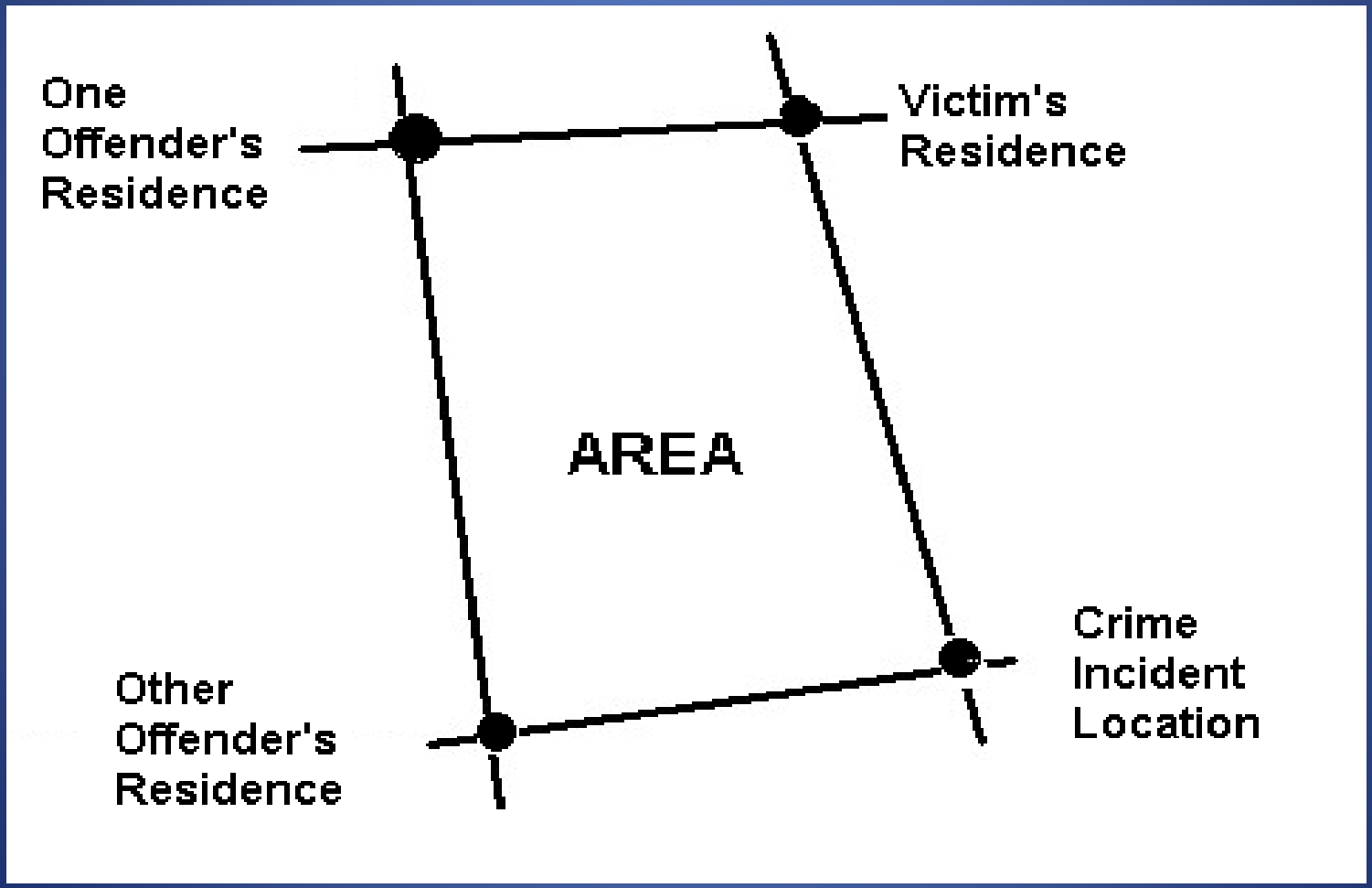
Why important?

- Mobility triangles can summarize a lot of information, taking into account address of offender, of victim, and of the crime itself
- The **area covered** tells us how geographically dispersed the crime's components are

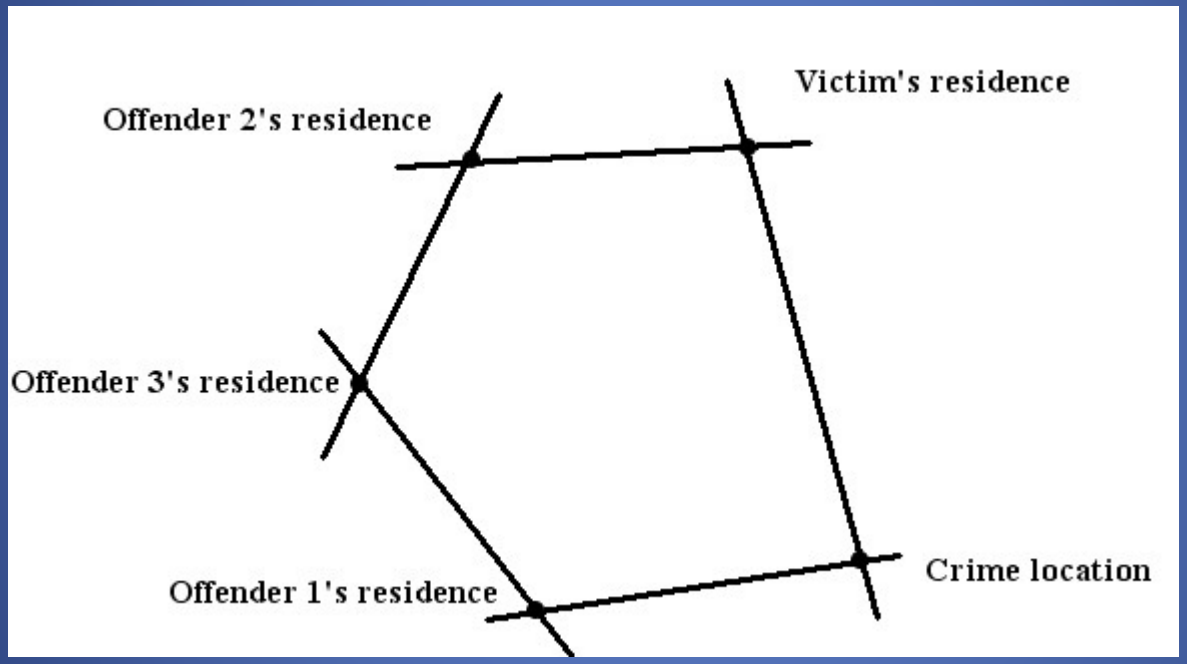
Enter co-offenders

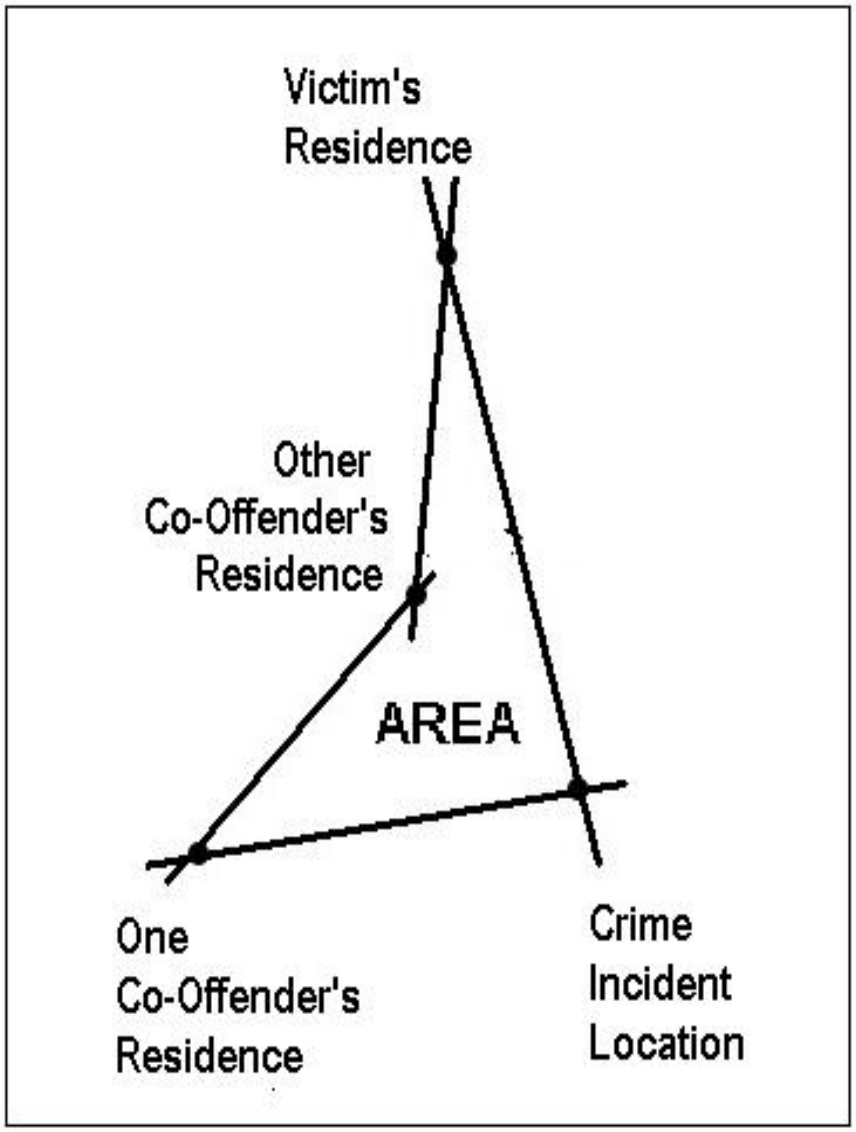
- Suppose two offenders live in different locations, commit their criminal act in a third place on a victim living in a fourth place
- You need a crime mobility *polygon*
- More than three points, too, when considering
  - multiple victims not living together
  - Bystanders
  - two crime scenes

Basic mobility polygon for two offenders



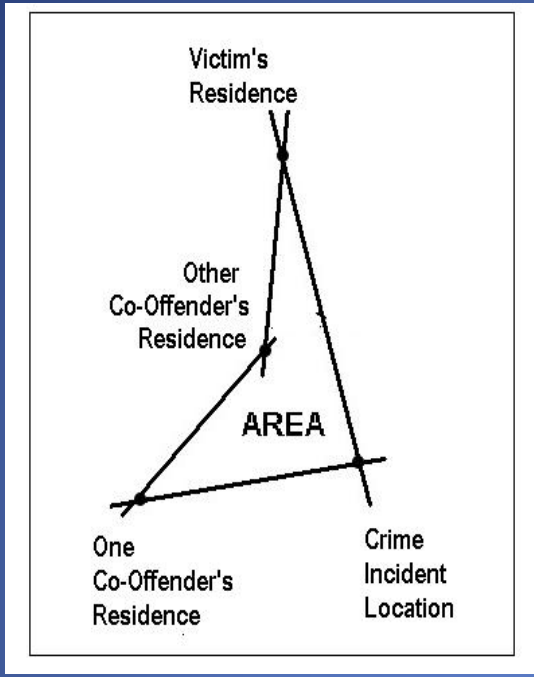
Crime pentangle (subtype of crime polygon for 3 offenders)





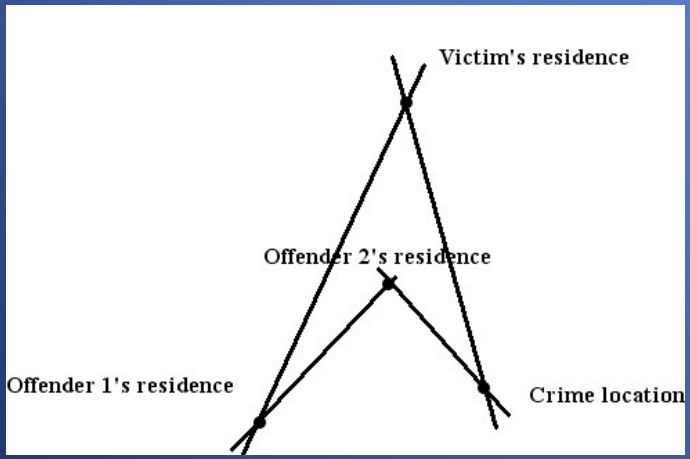
It can also be concave

So an extra offender *might reduce* the area of a mobility polygon



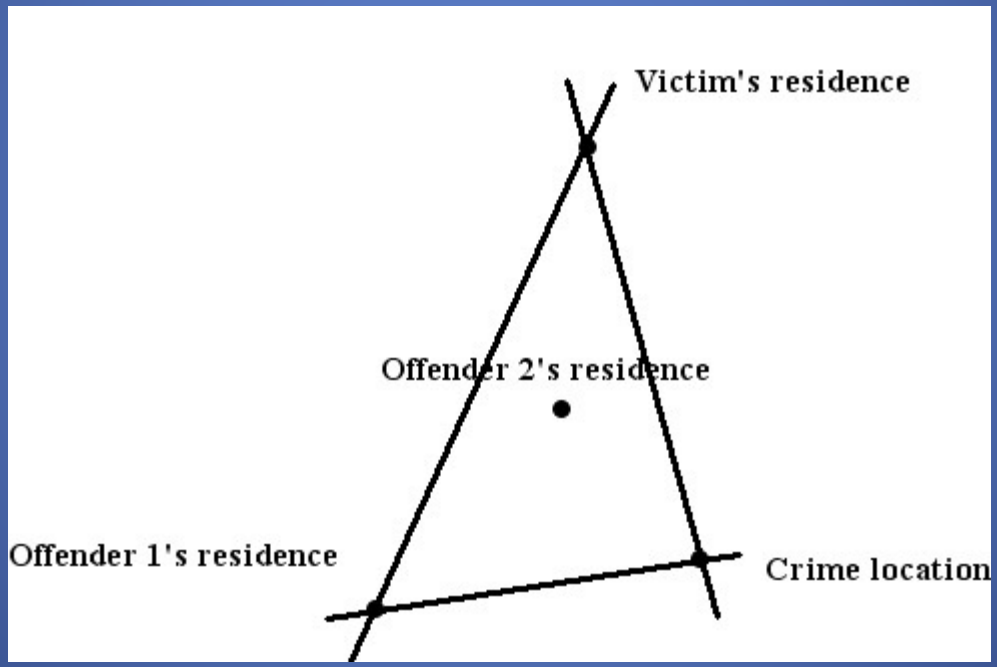
It can also be concave

Or make the case ambiguous



Which polygon to choose?

Sometimes you may want to overrule the concavity



Minimum mobility polygon area

- Zero - woman hits man within shared apartment
- (Technically, could be a few feet travelled)

Maximum mobility polygon area

Offender from Greenland goes to Australia and victimizes a tourist from Chile

- Greenland to Australia 14,769 km
- Chile to Australia 13,291 km
- Chile to Greenland 7,198 km

Mobility triangle area 47,764,430 sq km. NEGLECTING the curvature of the earth.

Go to a triangle area calculator, e.g.:
http://mste.illinois.edu/dildine/tcd_files/program17.htm

More interesting than a single mobility polygon

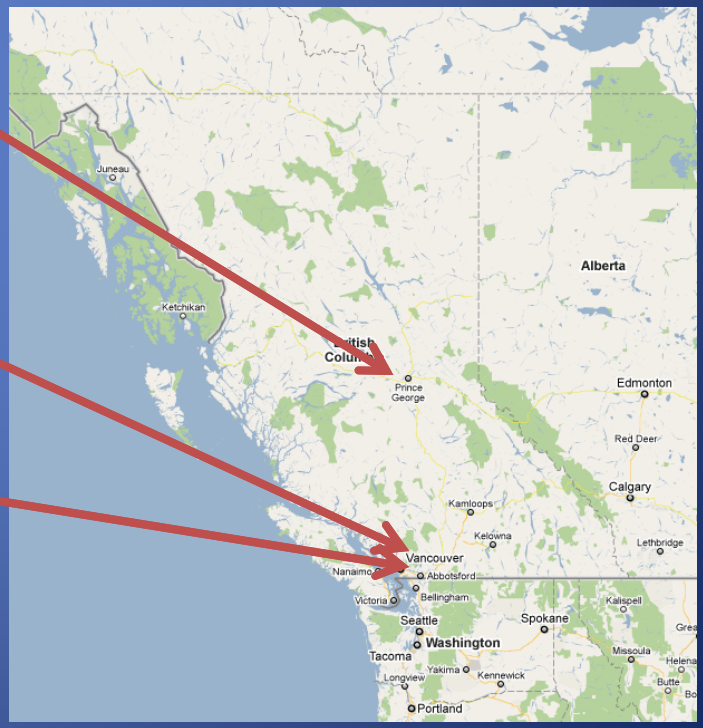
- Sum up a group of mobility polygon areas
- Use measures of centrality and dispersal
- Thus compare nations, cities, crime types, offender types, or whatever you like
- Crime in space is very complex, so it's nice to extract some summary indicators

The long distance issue

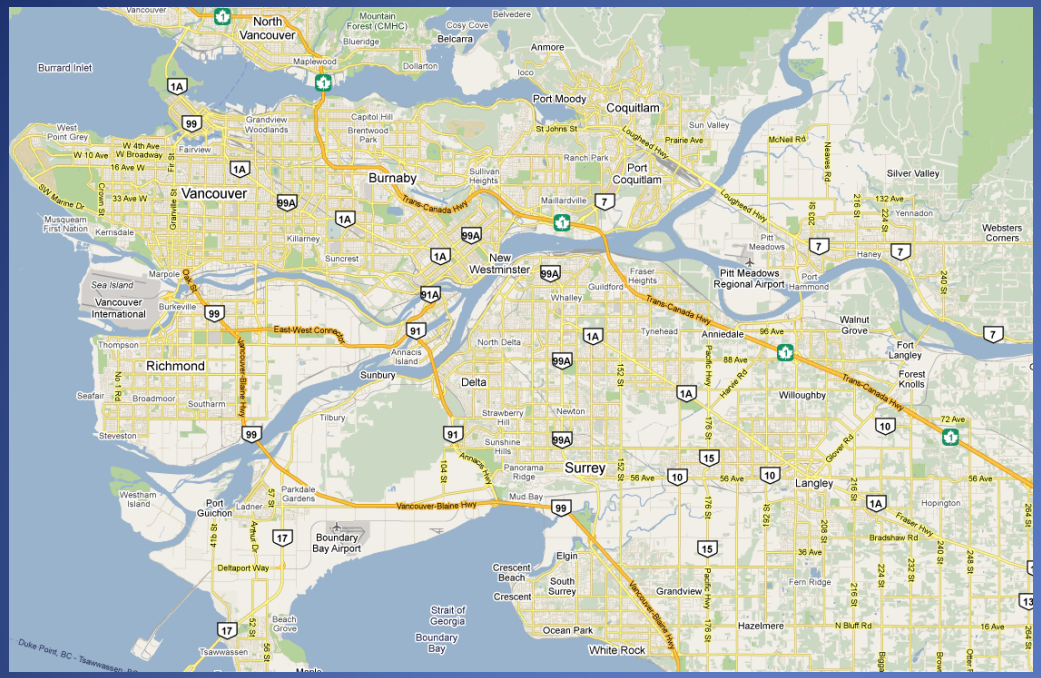
- Many crime participants are visitors or tourists
- Extreme travel distances can dominate
- To reduce extreme values, use **medians**, not means
- Median arae of crime mobility polygon *summarizes* the spatial expanse of a sample of crime incidents

Some empirical work

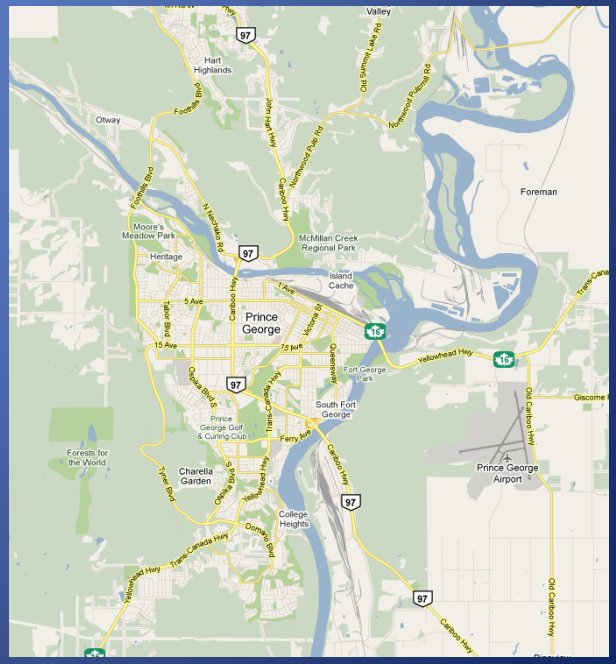
- British Columbia
- Test cases in British Columbia, Canada
  - Prince George (PG)
    - Rural
    - Population 71,000
  - Coquitlam (C)
    - metropolitan populations
    - Population 115,000
  - Surrey (S)
    - metropolitan populations
    - Population 400,000



- Surrey & Coquitlam



- Prince George



Crime Type	Count	Percent
Aggravated Assault	1096	14.9%
Assault	2923	39.7%
Homicide	80	1.1%
Sexual Assault	751	10.2%
Armed Robbery	462	6.3%
Robbery	318	4.3%
Commercial Burglary	66	0.9%
Other Burglary	86	1.2%
Residential Burglary	337	4.6%
Theft	490	6.7%
Theft from Motor Vehicle	245	3.3%
Theft of Motor Vehicle	503	6.8%
Total	7357	100.0%

- Summary statistics by crime type
- Total crimes in our 3 study cities

Offenders	Victims	Count	Percent
1	1	5321	72.3%
1	2	912	12.4%
2	1	902	12.3%
2	2	222	3.0%
Total		7357	

- Summary statistics by # of offenders and victims
- Each also has an event location!

Coquitlam – 1 offender, 1 victim

Crime Classification	First Quartile	Median	Third Quartile	Interquartile Range	Counter
Aggravated Assault	0.4	1.9	6.7	6.3	92
Assault	0.4	2.2	11.5	11.1	300
Homicide	0.4	64.8	64.8	64.4	3
Sexual Assault	1.0	3.8	33.9	32.9	64
Armed Robbery	0.4	1.2	6.8	6.4	61
Robbery	0.8	2.6	13.8	13.0	24
Commercial Burglary	2.0	16.9	16.9	14.9	3
Other Burglary	0.0	33.9	33.9	33.8	3
Residential Burglary	0.3	2.9	4.0	3.7	7
Theft	1.2	4.6	13.2	12.0	38
Theft from Motor Vehicle	0.1	0.4	5.6	5.5	23
Theft of Motor Vehicle	2.2	6.3	23.5	21.3	29

- First quartiles are small
- Medians vary
- Interquartile range also varies

Median Polygon Area
1 offender, 1 victim

	Coquitlam	Prince George	Surrey
Aggravated Assault	1.9	1	1
Assault	2.2	0.7	1.2
Homicide	64.8	1	2.7
Sexual Assault	3.8	1.7	4
Armed Robbery	1.2	1.2	3.2
Robbery	2.6	0.7	2.3
Commercial Burglary	16.9	3.2	0.8
Other Burglary	33.9	0.4	1.4
Residential Burglary	2.9	0.4	0.2
Theft	4.6	0.8	2
Theft from Motor Vehicle	0.4	3	2.1
Theft of Motor Vehicle	6.3	4.4	5.1

- Coquitlam is more 'variable'
  - Why?
- Polygon for Theft of Motor Vehicle
  - Largest for PG and S
  - Average for C?

Median Polygon Area Surrey

	1 Offender, 1 Victim	1 Offender, 2 Victims	2 Offenders, 1 Victim	2 Offenders, 2 Victims
Aggravated Assault	1	3	2.3	5.2
Assault	1.2	2.5	3	7.7
Homicide	2.7	14.5	4.1	16.8
Sexual Assault	4	3.3	4.8	1.5
Armed Robbery	3.2	5.2	4.6	13.4
Robbery	2.3	6.3	7.1	4.9
Commercial Burglary	0.8	25.5	21.9	5.6
Other Burglary	1.4	0.5	9.1	13.5
Residential Burglary	0.2	1.9	2.1	0.7
Theft	2	8.4	1.6	8.3
Theft from Motor Vehicle	2.1	0.4	12.3	98.7
Theft of Motor Vehicle	5.1	11.8	6.6	19

- The addition of a 2nd *victim* increases area
  - but not in all cases?
- The addition of a 2nd *offender* also increases area
  - To different degrees than above?

Conclusions so far

- Number of victims spreads out the mobility polygon the most
- Number of offenders has an impact, too
- Not automatic or predictable
- Counter tendencies!
  - Co-offending draws on a larger area, BUT
  - propinquity can set up an offending group

Note that

- Violent and property crimes intermingle for lesser and greater areas covered
- Theft from and of motor vehicles differ
- Standard deviations sensitivity to extreme values.
- But also the variation confirms Ron's basic point is right – crime types must be disaggregated quite a bit

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Thank you!

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