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Place for Spatial Big Data Analytics

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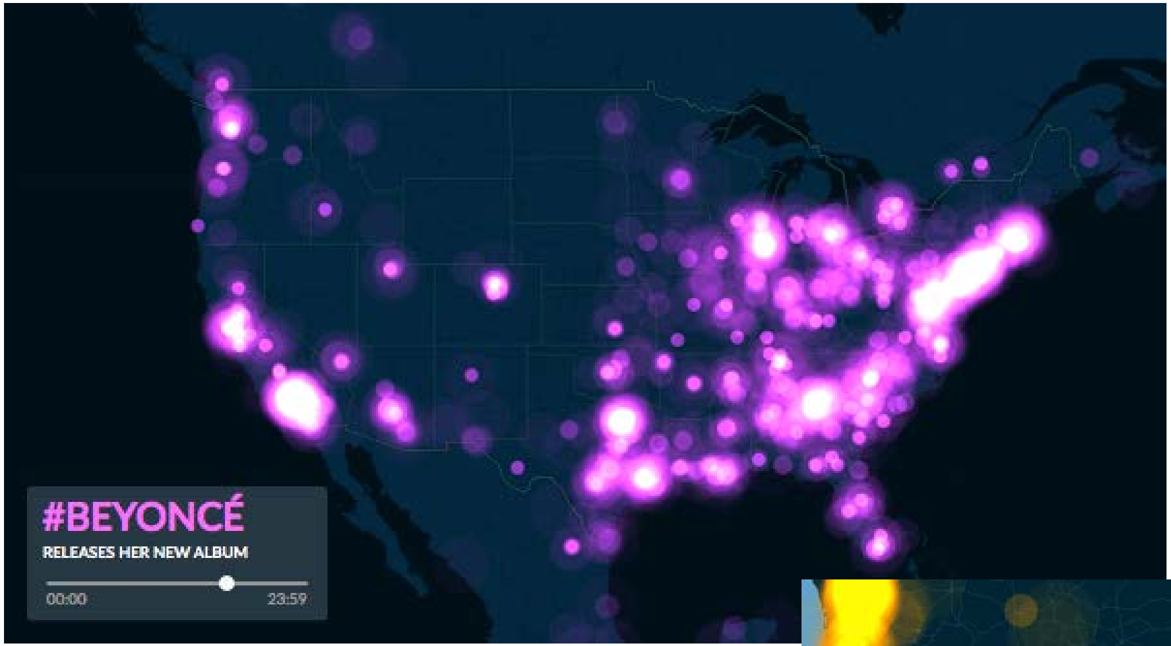
https://cartodb.com/solutions/twitter-maps/



Difficult
to grasp

Data are deluging;

Places are emerging.

Visible
Perceivable
Locatable

Peter Fisher and David Unwin (2005) Representing GIS

Time

- Space vs. place
  - Euclidean spaces; containers
  - Socially-produced and continually changing notion of place
- The social world that people experience

Human activities and events

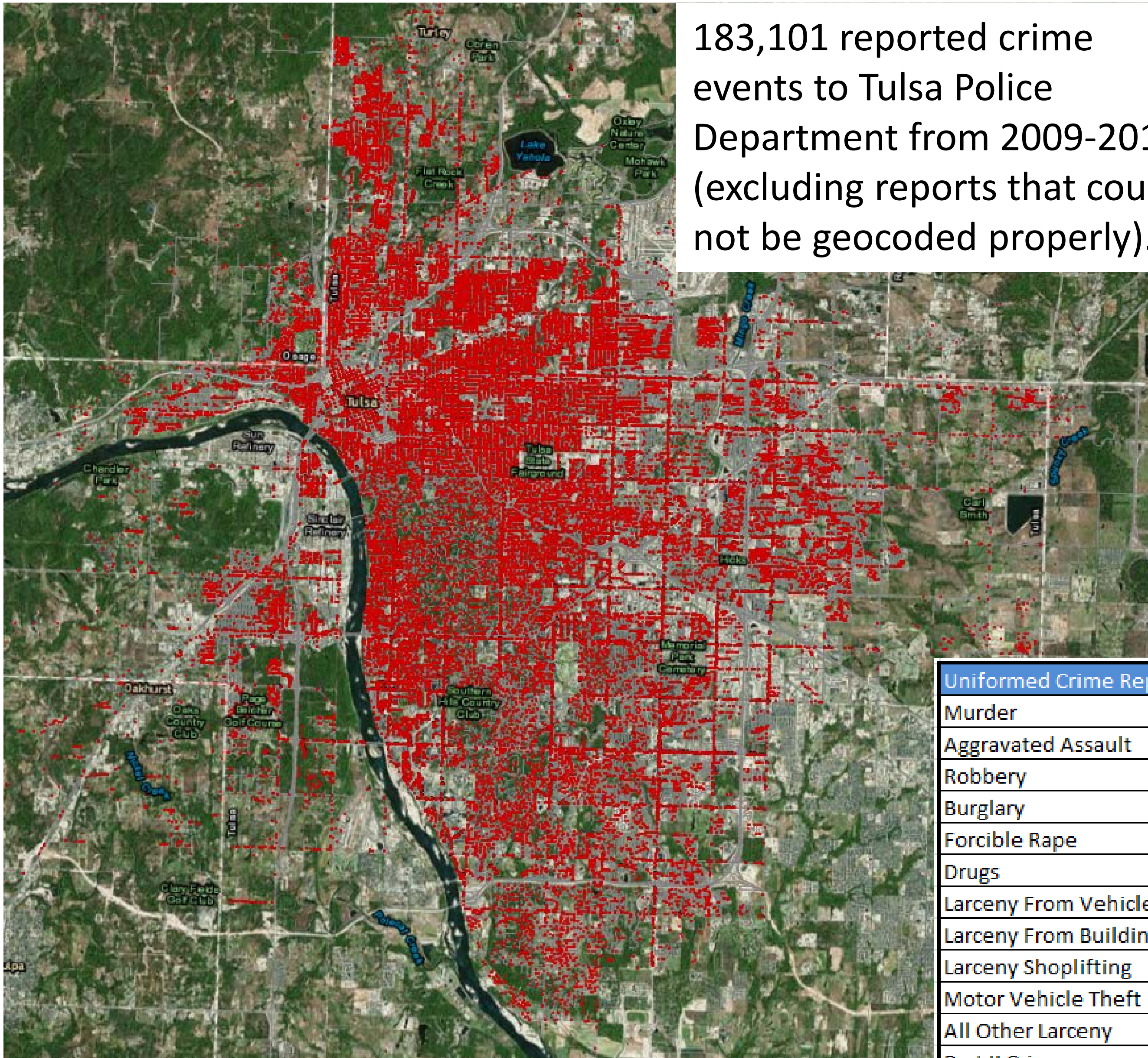
Yi-Fu Tuan (1979): Space and Place from the Humanistic Perspective

Space and place together define the nature of geography

- **Place: a unique entity, a "special assemble"**
  - ✓ **History and meaning**
  - ✓ **Experiences and aspiration of a people**
  - ✓ **A fact to be explained in the broader frame of space**
  - ✓ **A reality to be clarified and understood from the perspective of the people who have given it meaning**

Data prescribe experiences and drive emergence of places.

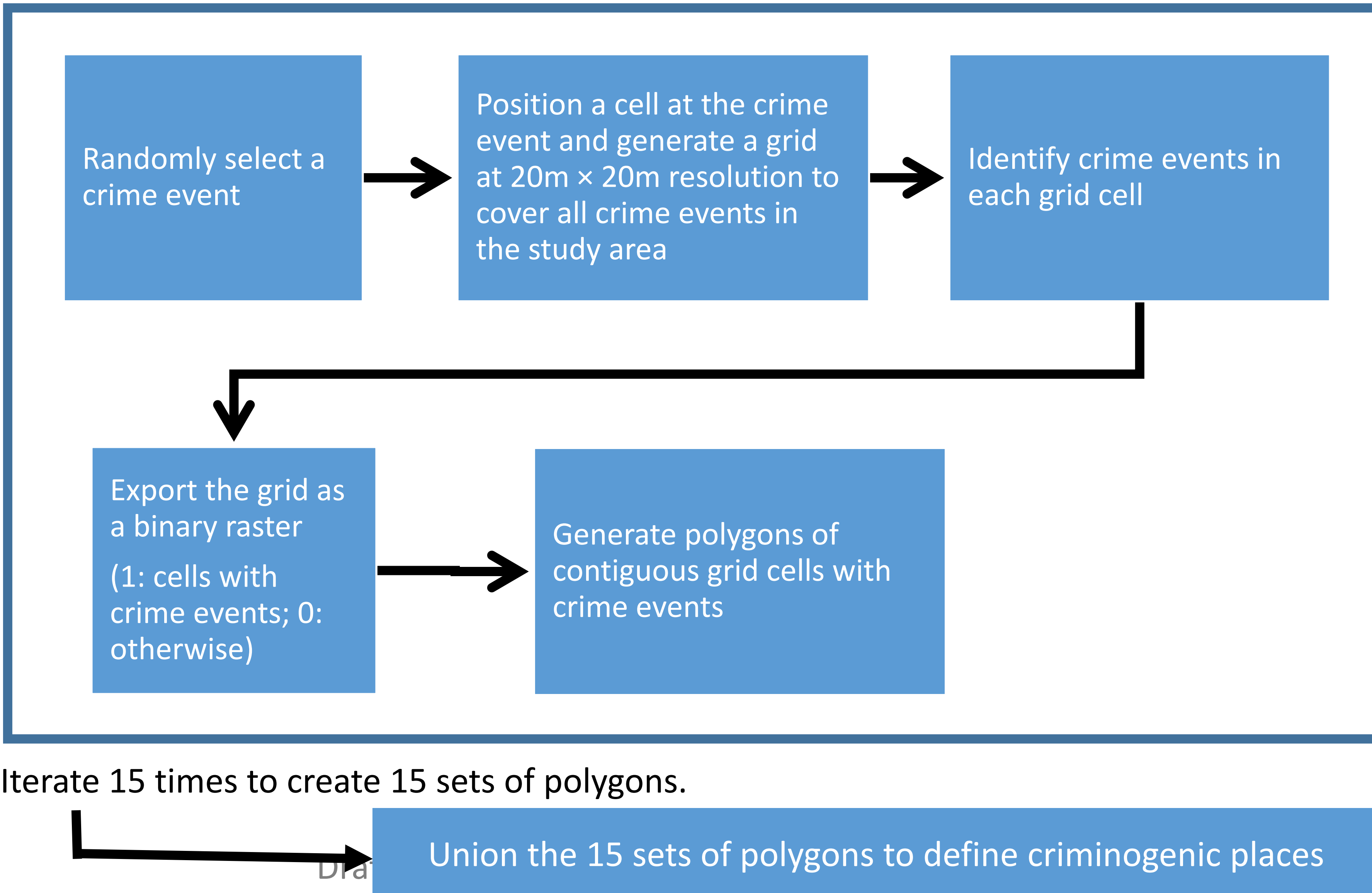
Places summarize data and synthesize experiences.



183,101 reported crime events to Tulsa Police Department from 2009-2011 (excluding reports that could not be geocoded properly).

Uniformed Crime Reporting Code	Reports
Murder	168
Aggravated Assault	7734
Robbery	3427
Burglary	19435
Forcible Rape	740
Drugs	4699
Larceny From Vehicle	9843
Larceny From Building	2345
Larceny Shoplifting	8099
Motor Vehicle Theft	7206
All Other Larceny	15678
Part II Crime	103727

events as experiences to define places



Polygons generated from 15 iterations

Places defined by crime events: Criminogenic places

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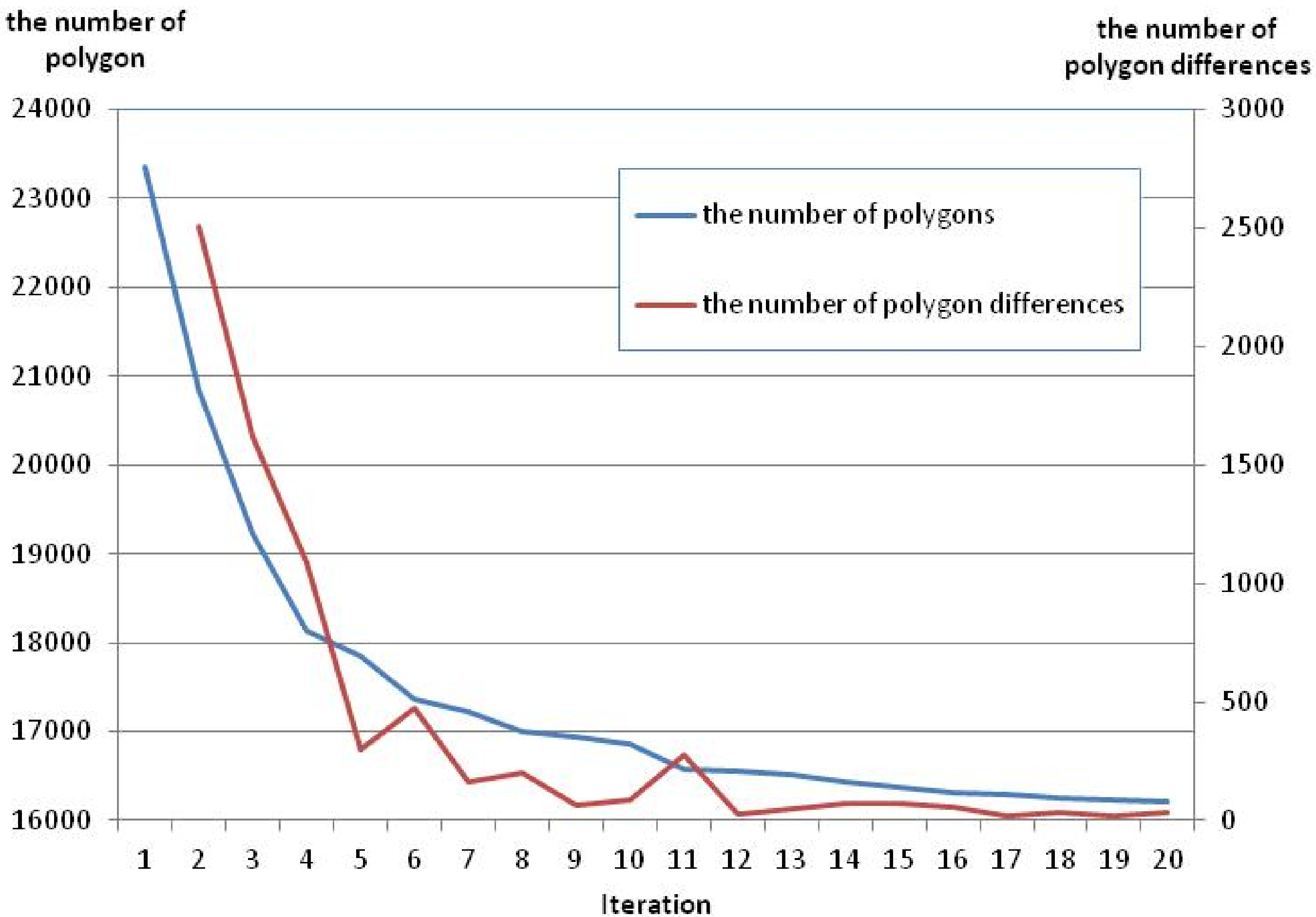
Iterations stabilize the delineation of places



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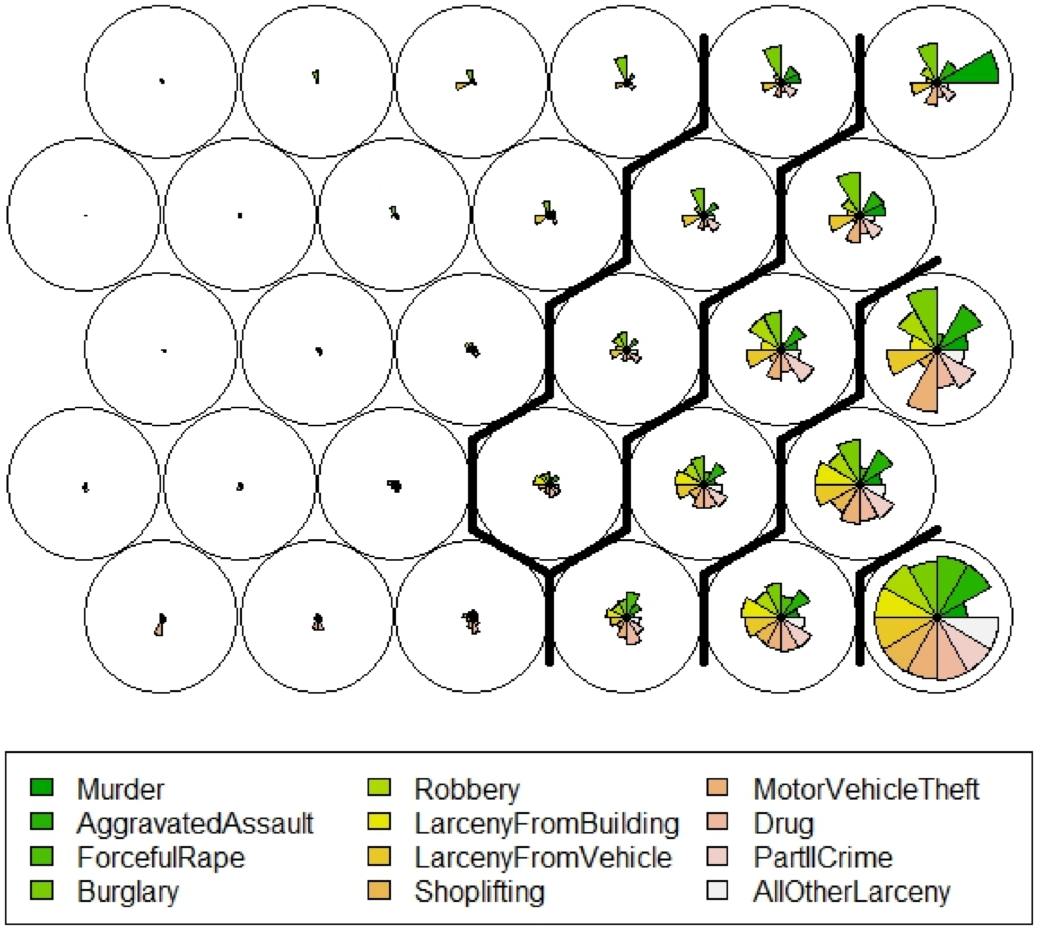
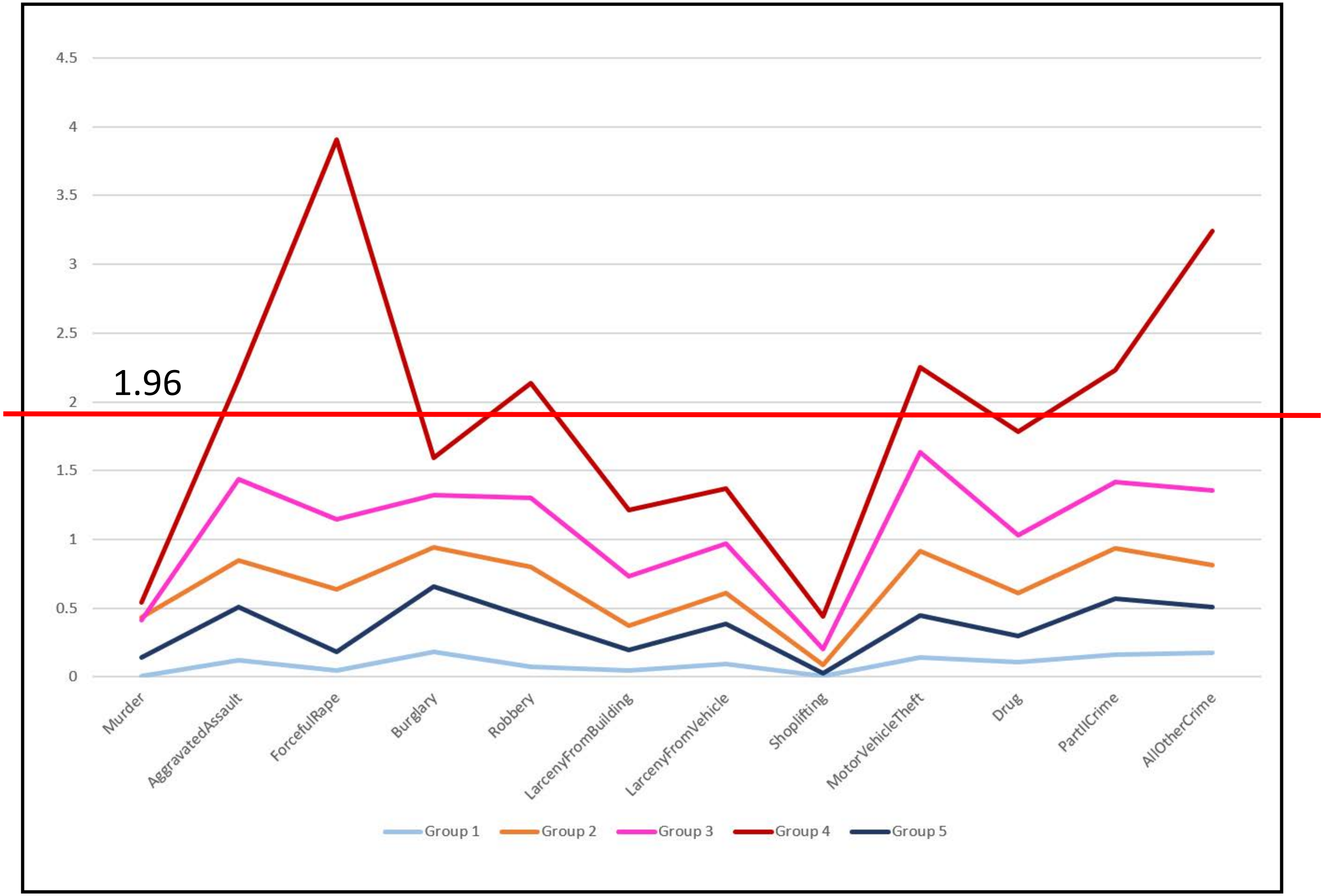

Murder
AggravatedAssault
ForcefulRape
Burglary
Robbery
LarcenyFromBuilding
LarcenyFromVehicle
Shoplifting
MotorVehicleTheft
Drug
PartIICrime
AllOtherLarceny

Relative Distributions of Crime Types (mean Z-scores in each type)



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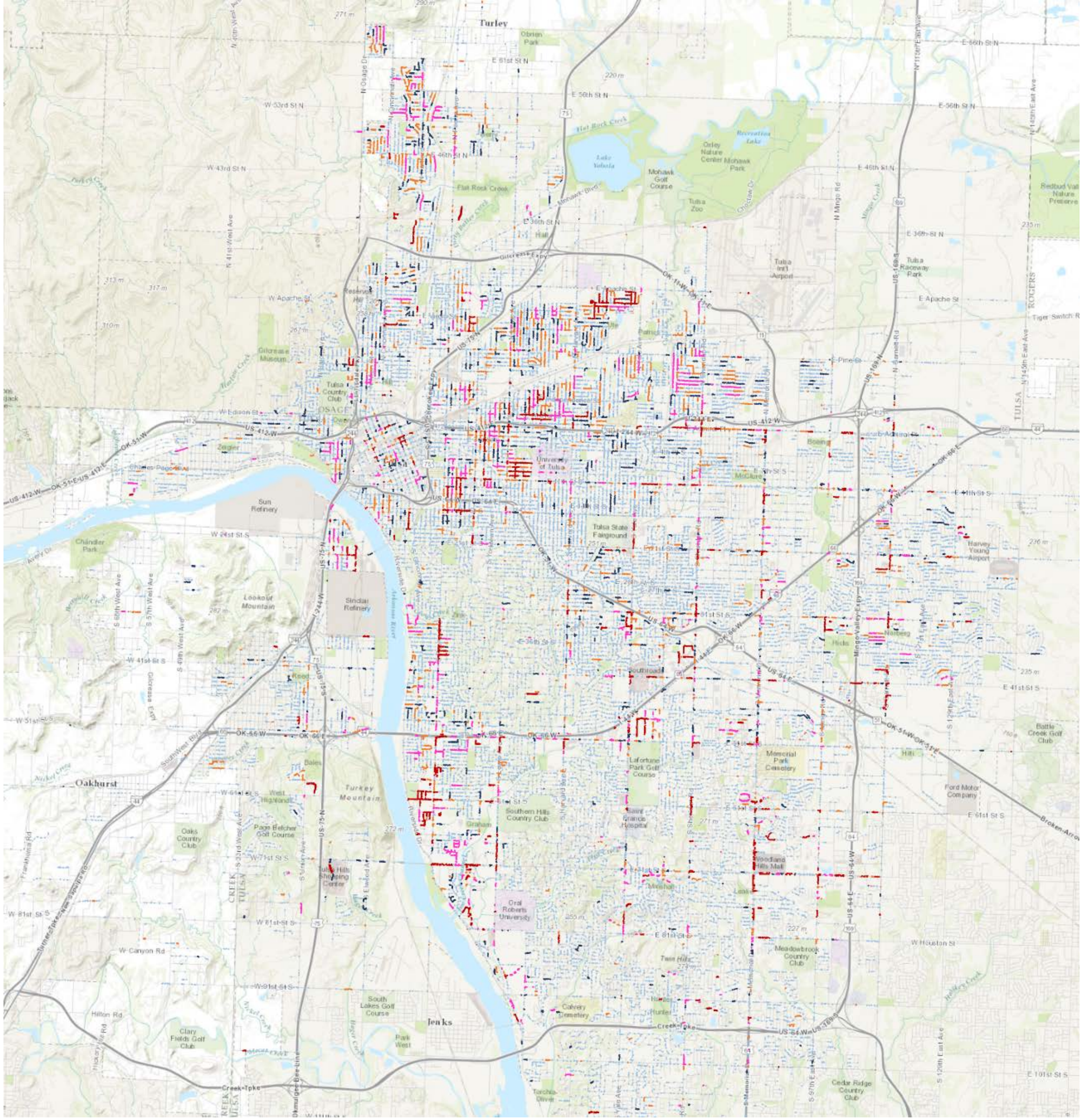

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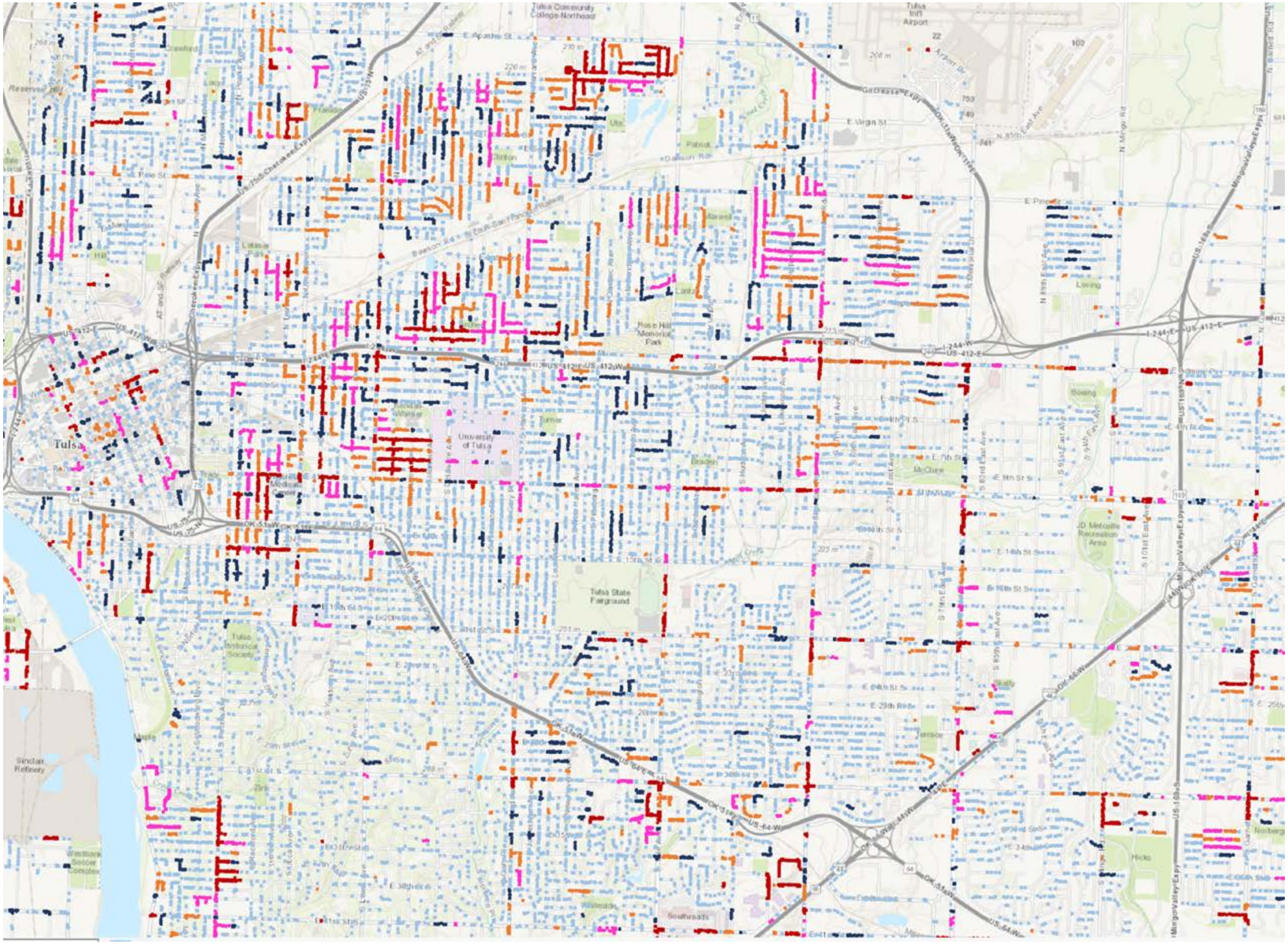

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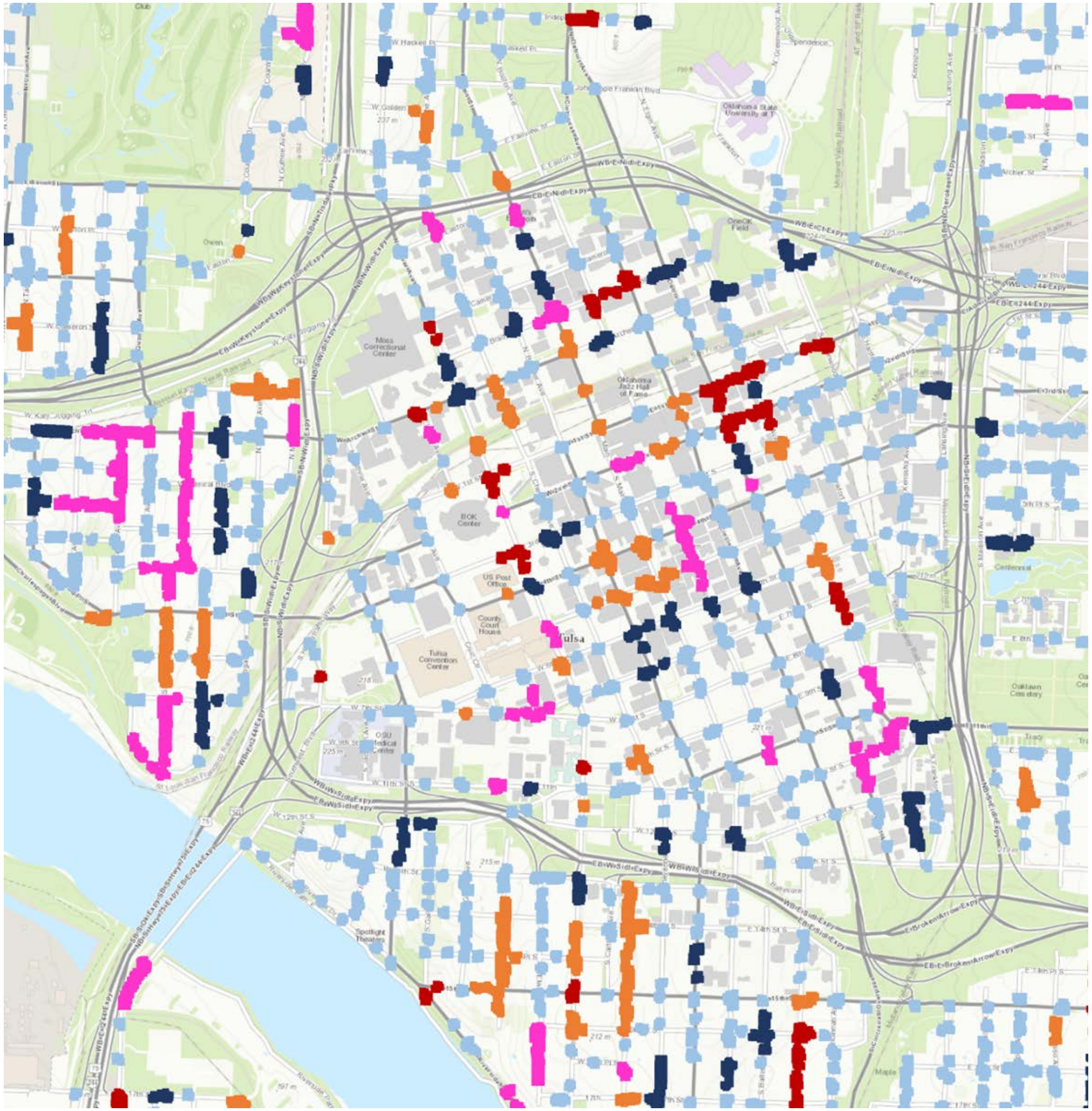

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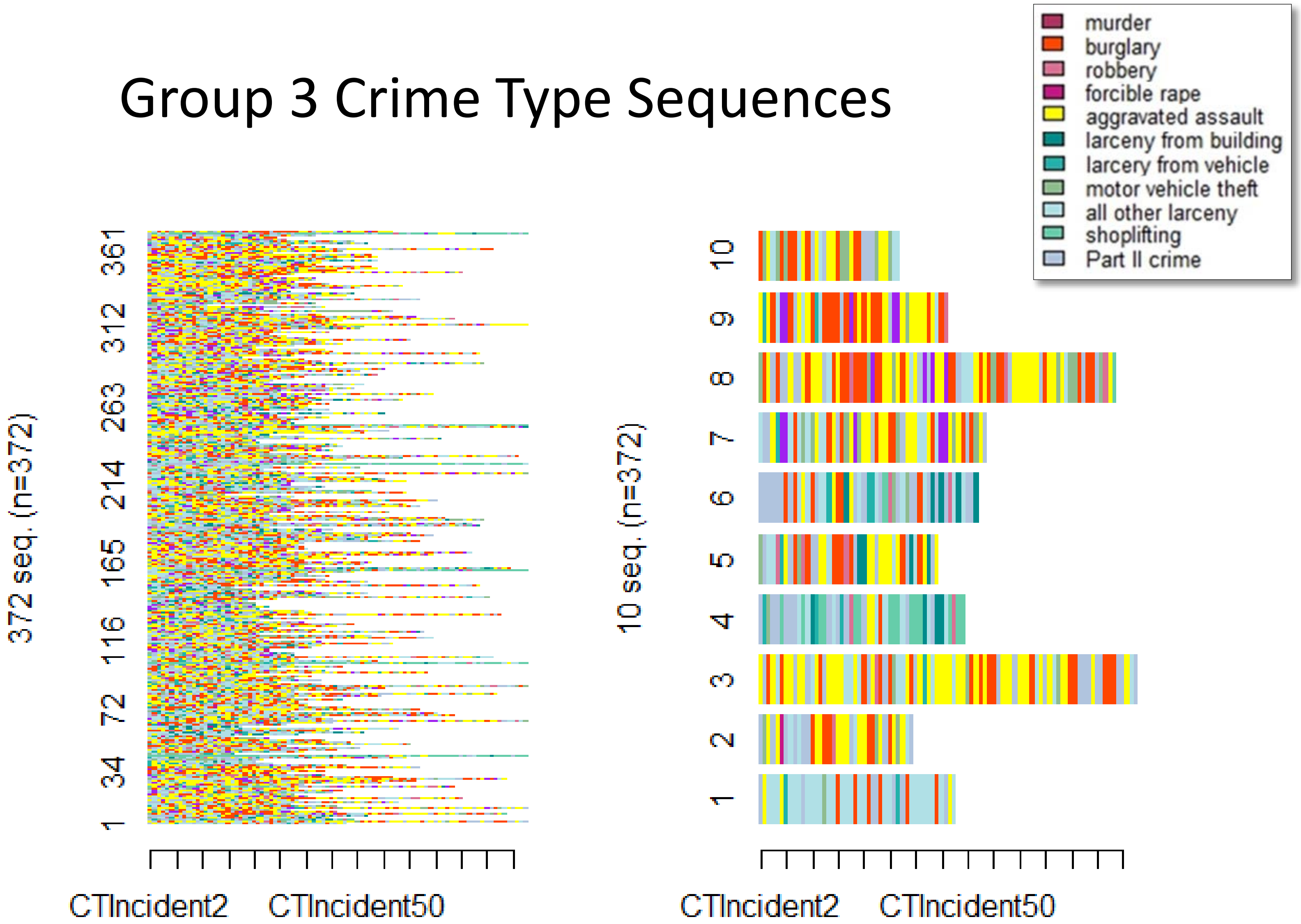
Group	# of Segments	% Segments	Lengths (m)	% Lengths
0	8,208	23.6%	2,743,577	68%
1 (lowest)	17,472	50.3%	862382	21.4%
2 (3rd lowest)	3,021	8.7%	137491	3.4%
3 (2nd highest)	1,797	5.2%	89788	2.2%
4 (highest)	1,681	4.8%	83173	2%
5 (2nd lowest)	2,584	7.4%	121029	3%
Total	34,763	100%	4,037,440	100%

~25%

~10%

Group 3 Crime Type Sequences



All places

First 10 common sequence patterns

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Probability to crime types in Group 3

	[-> NA]	[-> AA]	[-> AOL]	[-> BG]	[-> DG]	[-> FR]	[-> LB]	[-> LV]	[-> MVT]	[-> MD]	[-> P2C]	[-> RB]	[-> SL]	
[NA ->]	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
[AA ->]	0.02	0.34	0.14	0.16	0.04	0.01	0.02	0.03	0.07	0.00	0.14	0.03	0.01	1.01
[AOL ->]	0.02	0.21	0.26	0.13	0.03	0.01	0.03	0.04	0.08	0.00	0.14	0.03	0.03	1.01
[BG ->]	0.03	0.24	0.14	0.26	0.03	0.00	0.01	0.03	0.08	0.00	0.14	0.03	0.01	1.00
[DG ->]	0.02	0.22	0.13	0.13	0.13	0.00	0.04	0.02	0.09	0.00	0.16	0.03	0.03	1.00
[FR ->]	0.02	0.28	0.16	0.15	0.06	0.00	0.02	0.06	0.06	0.00	0.14	0.03	0.02	1.00
[LB ->]	0.03	0.20	0.21	0.06	0.03	0.00	0.12	0.03	0.07	0.00	0.15	0.04	0.05	0.99
[LV ->]	0.02	0.21	0.20	0.15	0.04	0.00	0.02	0.09	0.07	0.00	0.15	0.02	0.02	0.99
[MVT ->]	0.02	0.24	0.15	0.17	0.04	0.00	0.01	0.04	0.14	0.00	0.13	0.03	0.02	0.99
[MD ->]	0.00	0.15	0.15	0.08	0.00	0.00	0.00	0.08	0.08	0.00	0.31	0.15	0.00	1.00
[P2C ->]	0.02	0.21	0.14	0.14	0.04	0.00	0.02	0.03	0.07	0.00	0.22	0.04	0.05	0.98
[RB ->]	0.02	0.22	0.16	0.13	0.07	0.00	0.02	0.02	0.09	0.00	0.17	0.08	0.04	1.02
[SL ->]	0.01	0.06	0.10	0.02	0.03	0.00	0.04	0.01	0.03	0.00	0.16	0.03	0.52	1.01
	1.23	2.58	1.94	1.58	0.54	0.02	0.35	0.48	0.93	0.00	2.01	0.54	0.80	13.00
	0.09	0.20	0.15	0.12	0.04	0.00	0.03	0.04	0.07	0.00	0.15	0.04	0.06	

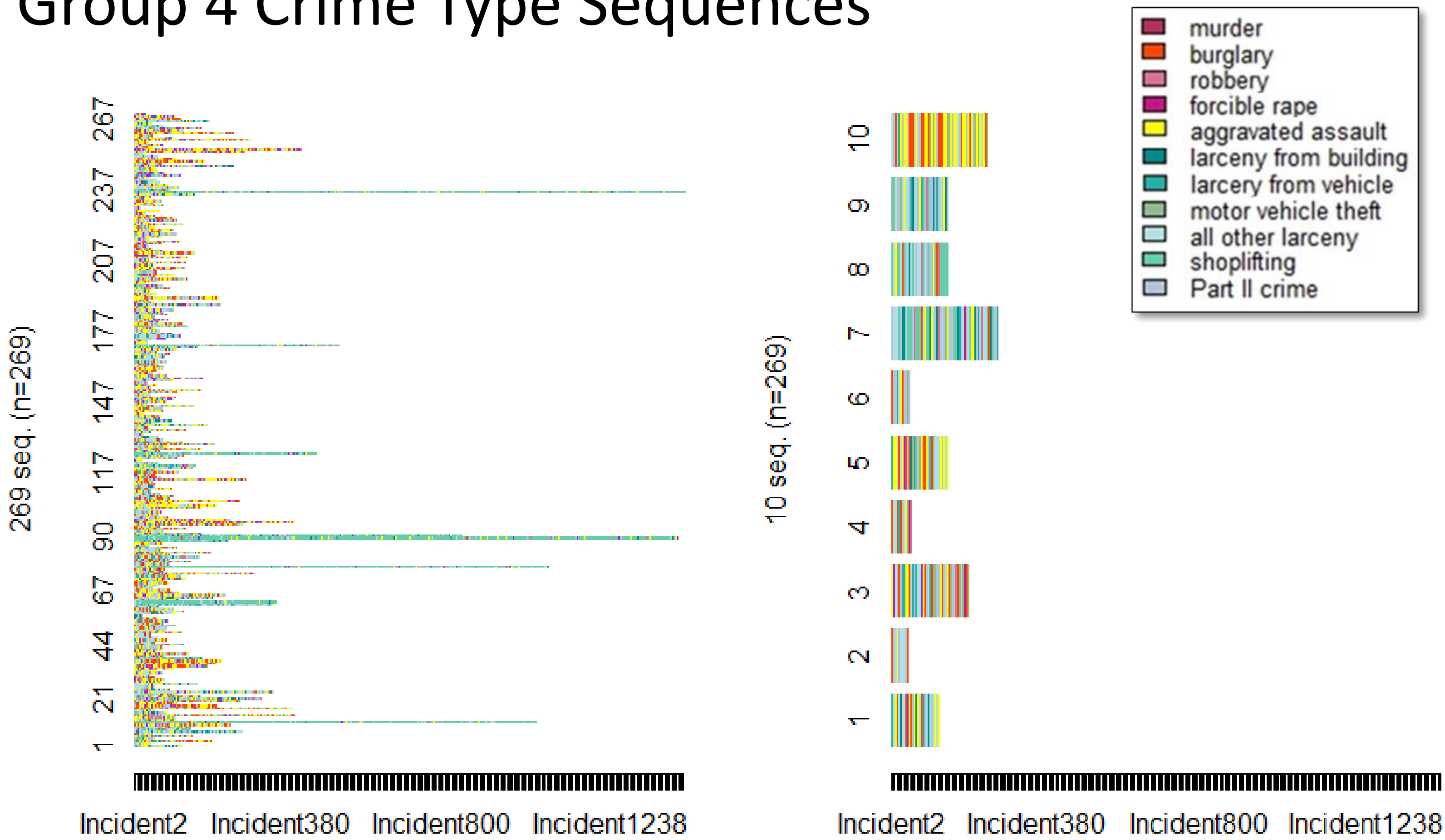
NA	
AA	aggravated assault
AOL	all other larceny
BG	burglary
DG	drug
FR	forcible rape
LB	larceny from building
LV	larceny from vehicle
MVT	motor vehicle theft
MD	murder
P2C	Part II crime
RB	robbery

Relatively high transition probability

Relatively high fidelity of crime types at places

31% of P2C preceded by Murders.

Group 4 Crime Type Sequences



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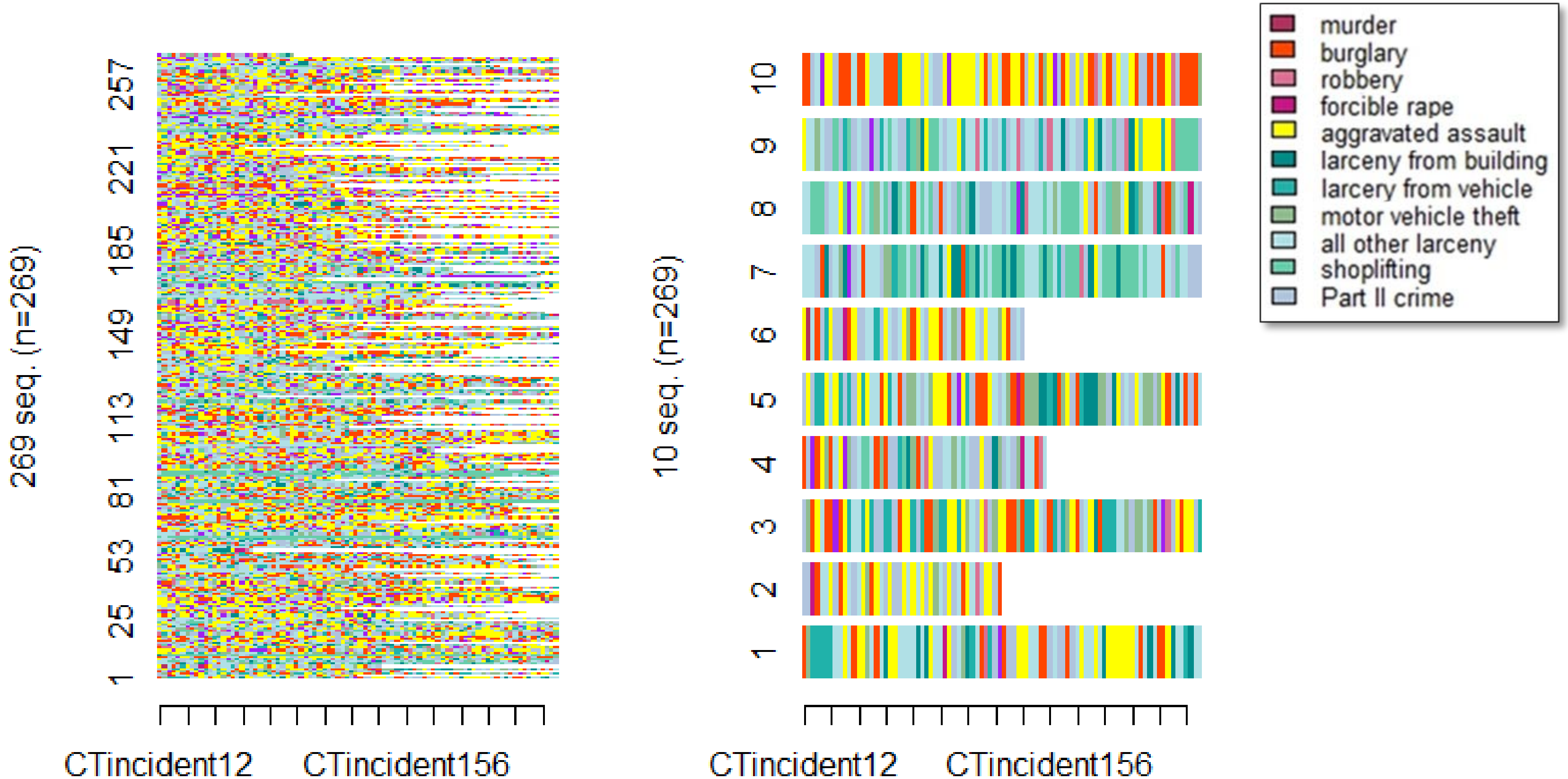
Group 4 Crime Type Sequences: first 80 crime events



All places

First 10 sequence patterns

Probability to crime types in Group 4

	[-> NA]	[-> AA]	[-> AOL]	[-> BG]	[-> DG]	[-> FR]	[-> LB]	[-> LV]	[-> MVT]	[-> MD]	[-> P2C]	[-> RB]	[-> SL]	
[NA ->]	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
[AA ->]	0.01	0.33	0.14	0.13	0.05	0.01	0.02	0.02	0.06	0.00	0.14	0.04	0.04	0.99
[AOL ->]	0.01	0.17	0.29	0.09	0.04	0.01	0.04	0.04	0.06	0.00	0.14	0.04	0.09	1.02
[BG ->]	0.01	0.25	0.13	0.24	0.04	0.02	0.01	0.03	0.06	0.00	0.15	0.04	0.02	1.00
[DG ->]	0.00	0.23	0.14	0.09	0.16	0.01	0.02	0.02	0.05	0.00	0.18	0.04	0.05	0.99
[FR ->]	0.01	0.29	0.13	0.13	0.05	0.05	0.03	0.02	0.06	0.00	0.15	0.05	0.02	0.99
[LB ->]	0.01	0.14	0.23	0.04	0.03	0.01	0.12	0.03	0.05	0.00	0.13	0.03	0.17	0.99
[LV ->]	0.00	0.17	0.21	0.09	0.02	0.01	0.02	0.11	0.05	0.00	0.15	0.04	0.11	0.98
[MVT ->]	0.01	0.22	0.16	0.13	0.04	0.01	0.03	0.03	0.10	0.00	0.17	0.04	0.05	0.99
[MD ->]	0.00	0.28	0.15	0.12	0.08	0.00	0.00	0.00	0.08	0.08	0.22	0.00	0.00	1.01
[P2C ->]	0.01	0.20	0.15	0.11	0.05	0.01	0.03	0.03	0.06	0.00	0.20	0.04	0.11	1.00
[RB ->]	0.01	0.22	0.16	0.11	0.05	0.01	0.03	0.03	0.07	0.00	0.16	0.08	0.08	1.01
[SL ->]	0.00	0.04	0.08	0.01	0.01	0.00	0.03	0.01	0.01	0.00	0.08	0.02	0.70	0.99
	1.08	2.54	1.97	1.29	0.62	0.15	0.38	0.37	0.71	0.08	1.87	0.46	1.44	13.00
	0.08	0.20	0.15	0.10	0.05	0.01	0.03	0.03	0.05	0.01	0.14	0.04	0.11	

NA	
AA	aggravated assault
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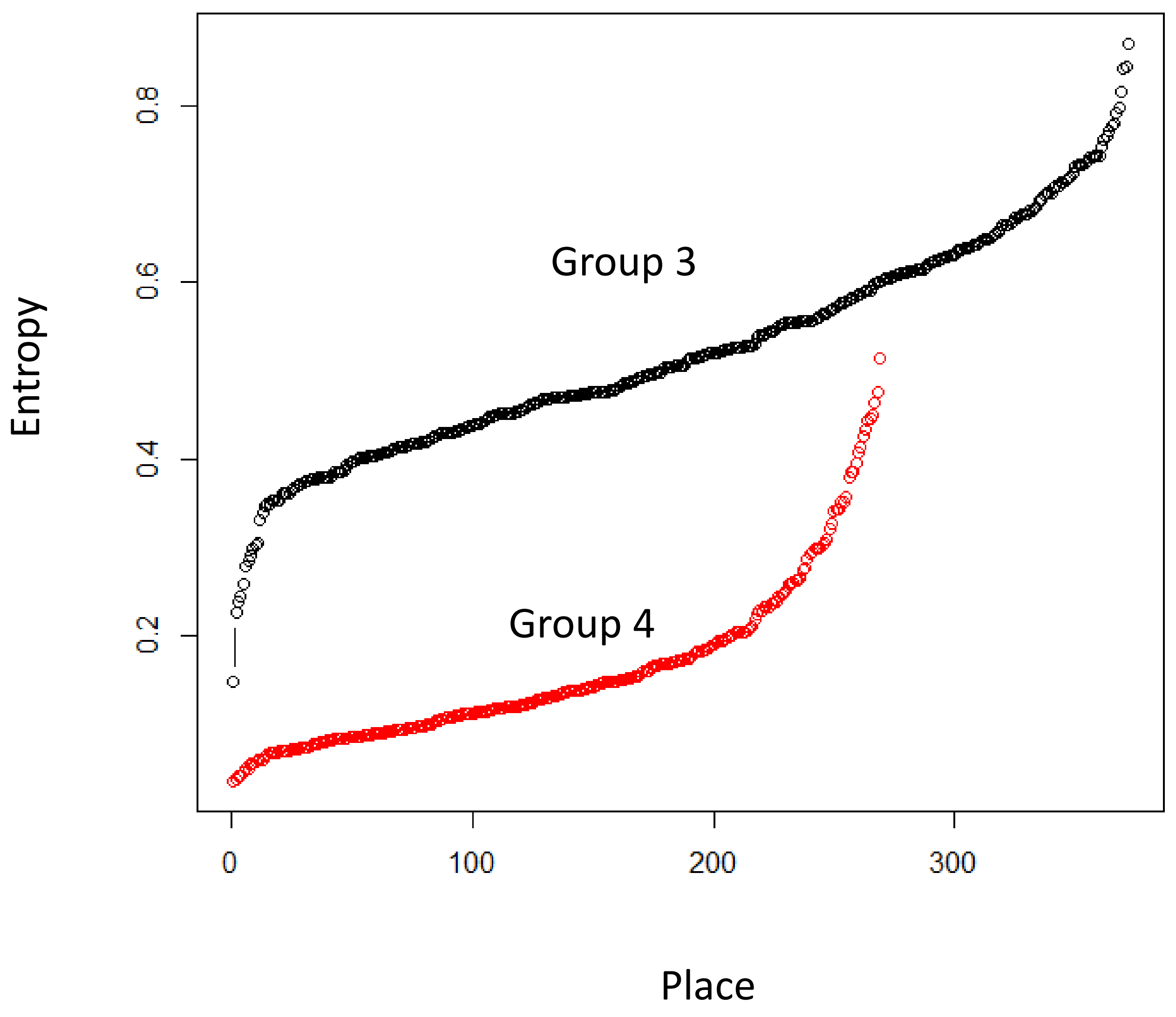
Relatively high fidelity of crime types at places



Entropy
0.2
0.4
0.6
0.8
Group 3
Group 4
0
100
200
300
Place

Thoughts

- space: absolute, container, Euclidean
- place: complex, organic, dynamic, experiential, experiential, and understandable
  - To Pete Fisher
    - Places are socially and dynamically produced
    - Uncertainty
    - Fuzziness
- Place for spatial big data
  - vertical integration of activities and events at places
  - from events to identify places
  - from places to predict event transitions