Estimating and Responding to Near-repeat Burglaries

POP 2018
Providence, RI

Elizabeth Groff, PhD (groff@temple.edu)
Travis Taniguchi, PhD (taniguchi@rti.org)

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Agenda

Part 1: A primer on near repeat patterns
  • Definitions and terms
  • Existing knowledge
  • Importance of considering crime prevention potential

Part 2: NR Crime Prevention Potential Calculator

Part 3: Example analysis in Philadelphia
Part 1: Background

What is the near repeat pattern of burglary and why should I care?

Part 1: Repeat and near repeat burglary

• Repeat burglary phenomenon
  • Same house victimized multiple times
• Near repeat burglary phenomenon
  • Burglary increases risk for houses nearby
  • Space-time window varies
• Instigator/Originator event
  • First burglary
• Repeat event
  • Subsequent burglary within space-time window
Part 1: Near repeat burglary patterns

- Burglary occurrence associated with increased risk for neighbors
- Risk decays over time and space
- Size/duration of space-time high risk window varies

*What do we know about near repeat burglary patterns?*

Part 1: Size of high risk window

- Early studies international (UK, Australia)
  - Distance: 200 – 400 meters (656 - 1,328 feet)
  - Time: 2 – 4 weeks
- US studies increased since 2014
  - Distance: 100 – 244 meters (328 – 800 feet)
  - Time: 14 days or less
  - Baltimore County, MD; Houston, TX; Indianapolis, IN; Jacksonville, FL; Long Beach, CA; Newark, NJ; Pompano Beach, FL; Redlands, CA
- Must take quick action
- Size of area is reasonable
Part 1: Where do near repeats occur?

• Urban backcloth characteristics
  
• Near repeats more likely if:
  • Housing type and layout are similar
  • Public and other ‘at risk’ private housing complexes (Moreto et al, 2014)
  • Pawn shops (Moreto et al, 2014)
  • Drug markets (Moreto et al, 2014)
  • Burglar residences (Moreto et al, 2014)
  • Rivers (Piza and Carter, 2017)
  • Railroad tracks (Piza and Carter, 2017)

Part 1: Where do near repeats occur?

• Socio-economic indicators; micro and meso levels

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentrated disadvantage</td>
<td>Positive</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>Residential instability</td>
<td>Positive</td>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>Housing density</td>
<td>Positive</td>
<td>Positive</td>
<td>Positive</td>
</tr>
<tr>
<td>Racial heterogeneity</td>
<td>Positive</td>
<td>Positive</td>
<td>Positive</td>
</tr>
<tr>
<td>Young male population</td>
<td>Positive</td>
<td>Positive</td>
<td></td>
</tr>
</tbody>
</table>
Part 1: What works to prevent near repeats?

• Hot spots policing
  • Yes
    • Patrolled during high burglary times – 26% reduction (Fielding and Jones, 2012)
    • Patrolled places with past burglary concentration – 21% reduction (Santos and Santos, 2015a,b)
  • No
    • RCT in Holland (Elffers et al, 2018)
    • Why?
      – Most repeats occurred same day as initiator
      – Relatively few repeats overall

Part 1: What works to prevent near repeats?

• Non-police centric strategies

<table>
<thead>
<tr>
<th></th>
<th>Repeat victimization</th>
<th>Near repeat victimization micro (Neighborhood)</th>
<th>Near repeat victimization (Micro)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crime prevention</td>
<td>Yes</td>
<td>Positive</td>
<td>Mixed, positive</td>
</tr>
<tr>
<td>information</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target hardening tools</td>
<td>Yes</td>
<td>Positive</td>
<td>Mixed, positive</td>
</tr>
<tr>
<td>Notification of increased risk</td>
<td>Yes</td>
<td>Positive</td>
<td>Mixed, positive</td>
</tr>
<tr>
<td>Offer of a security audit</td>
<td>Yes</td>
<td>Positive</td>
<td>Mixed, positive</td>
</tr>
<tr>
<td>Uniformed personnel</td>
<td>Yes</td>
<td>Positive</td>
<td>Mixed, positive</td>
</tr>
</tbody>
</table>

References


Johnson, et al 2017

Groff and Taniguchi, 2018; Wellsmith and Birks, 2008
Part 1: Does notification increase fear?

Citizens do not report increased concern about crime

(Groff and Taniguchi, 2018; Johnson et al, 2017)

Part 1: What do volunteers think?

Volunteers liked participating
Felt the program improved police-community relations

(Groff and Taniguchi, 2018)
### Part 1: Tackling near repeat burglary

**Advantages:**
- Leverages volunteer corps for crime prevention
- Activates citizens in the co-production of community safety
- Basis for partnerships with other agencies and nonprofit groups
- Can be very low cost

**Challenges**
- **All burglaries versus actionable burglaries**
  - NRC uses all burglaries
  - Intervention focus: Stop pattern versus prevent initiating burglary
- Delays in reporting burglaries
- Non reporting of burglaries

**Determining the crime prevention potential of an intervention**
Crime prevention potential

• Number of crimes that could possibly be prevented by an intervention
• Shifts the focus from all crime to actionable crime

Part 1: Investigating the mystery

If NRC found significant space-time clustering, why did relatively few burglaries have follow-ons?

Can we better specify the potential impact of disrupting NR patterns?
Part 1: Measurement differences

- NRC
  - Each pair is classified so individual burglaries might 'count' toward more than one pair
  - Burglaries that occur on the same day as the originator event are not preventable but count as repeats
  - Distance is measured with Euclidean or Manhattan

Part 1: Value of CPP

- For practitioners
  - Should we undertake this intervention?
  - Was the intervention successful?
  - Is it worth continuing?
  - Measured at micro level

Realistic metric for evaluating program success
Part 1: A motivating scenario

Consider the scenario
*Two cities have 1,000 burglaries a year and implement an intervention to reduce that number...*

- Prior to implementation, the number of burglaries that were near repeats is calculated as 100.
- Burglaries in program areas go down by 50, a 50% reduction.
- Program expanded because of success.

Agency A

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Part 1: NR-CPP- Example

9 burglaries from January 1st through June 30th

High risk threshold
- 800 feet
- 30 days
Part 1: NR-CPP- Example

Filter on distance threshold
- Only connections within spatial threshold are shown

Part 1: NR-CPP- Example

- Consider timing and identify potential pairs

Example A
- (1) Jan. 3
- (2) Jan. 18
- (4) Feb. 1
- (5) March 20
- (6) April 18
- (7) April 19
- (8) May 20
- (9) June 17

Example B
- (3) Jan. 18
- (7) April 19

Example C
Part 1: NR-CPP- Example

### Example A

<table>
<thead>
<tr>
<th>Event</th>
<th>Event</th>
<th>Within Distance?</th>
<th>Different Day?</th>
<th>Within Time?</th>
<th>Event Allocated?</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>9</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
</tr>
</tbody>
</table>

No near repeat events in these examples

### Example B

<table>
<thead>
<tr>
<th>Event</th>
<th>Event</th>
<th>Within Distance?</th>
<th>Different Day?</th>
<th>Within Time?</th>
<th>Event Allocated?</th>
</tr>
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<tr>
<td>2</td>
<td>3</td>
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<td>×</td>
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</tr>
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</table>

### Example C

Two near repeat events in these examples

<table>
<thead>
<tr>
<th>Event</th>
<th>Event</th>
<th>Within Distance?</th>
<th>Different Day?</th>
<th>Within Time?</th>
<th>Event already allocated</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>6</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Event</th>
<th>Event</th>
<th>Within Distance?</th>
<th>Different Day?</th>
<th>Within Time?</th>
<th>Event already allocated</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>8</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Event</th>
<th>Event</th>
<th>Within Distance?</th>
<th>Different Day?</th>
<th>Within Time?</th>
<th>Event already allocated</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>7</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Event</th>
<th>Event</th>
<th>Within Distance?</th>
<th>Different Day?</th>
<th>Within Time?</th>
<th>Event already allocated</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>8</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
<td>×</td>
</tr>
</tbody>
</table>

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<tr>
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<th>Within Distance?</th>
<th>Different Day?</th>
<th>Within Time?</th>
<th>Event already allocated</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>8</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
</tr>
</tbody>
</table>
How can we automate this process?

We build a tool!

Part 1: NR-CPP - Methodology

Part 1: NR-CPP - Demonstration

- Examining open source data from seven cities (data.policefoundation.org/)
  - Denver
  - Durham
  - Fayetteville
  - Orlando
  - Philadelphia
  - Santa Rosa
  - Seattle
  - St. Louis
### Part 1: NR-CPP - Results

<table>
<thead>
<tr>
<th></th>
<th>Baltimore Co.</th>
<th>Redlands</th>
<th>Denver</th>
<th>Durham</th>
<th>Fayetteville</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3 Blocks</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4 Weeks</strong></td>
<td>5.89</td>
<td>7.76</td>
<td>14.97</td>
<td>14.30</td>
<td>14.51</td>
</tr>
<tr>
<td><strong>Orlando</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</table>

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>4 Blocks</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4 Weeks</strong></td>
<td>8.18</td>
<td>15.24</td>
<td>23.90</td>
<td>21.98</td>
<td>20.53</td>
</tr>
<tr>
<td><strong>Orlando</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Philadelphia</strong></td>
<td>30.77</td>
<td>35.84</td>
<td>16.47</td>
<td>26.31</td>
<td>32.97</td>
</tr>
</tbody>
</table>
NR-CPP - Variable patterns

Take away points

• Global NR risk ≠ actionable NR risk
• The CPP of NR varies by city and within cities
• CPP should be integrated into analysis process
  • Calculate CPP prior to designing intervention
  • Drill down the cone of resolution to identify ‘where’
• Quantify crime problem
  • Analysis: Should we undertake this intervention?
  • Assessment: Was the intervention successful?
QUESTIONS?

Part 2: Example using NR-CPPC

- All written guides, presentations and software are available at:

- Scroll down and look for Resources & Tools part of page
- Download software and sample data
- Read user guide
Part 2: NR-CPPC Interface

**Near Repeat Prevention Tool**

- Leave this field blank AND select “Network Distance”
  - Program will download and use OpenStreetMap data
- Link to a street file AND select “Network Distance”
  - Program will use your Shapefile
- Leave this field blank AND select other distance metric
  - No street file needed
Part 2: NR-CPP - Distance measurement

Network Distance

Manhattan Distance

Euclidean Distance
Part 2: NR-CPPC- Controlling what is counted

Option 1 - Allows events to be counted in multiple NR chains
Option 2 - Allows events to be originators and repeat events
Option 3 - Allows same-day events to be counted in NR chains

Robust evaluations would generally require leaving Options 1 & 2 unchecked.

Part 2: NR-CPP- Output files

Program writes out file called count.csv that has:

1. Count of events per space-time bin
2. Spatial min and max
3. Temporal min and max
Part 2: NR-CPP - Output files

Program writes out one file for each space-time bin that begin with ‘originator’

Each file has the id numbers for all events that were originators and the id numbers for all their associated repeat events

1. Originator_event_ids – may be duplicates
2. Repeat_event_id

Program writes out one file for each space-time bin that begin with ‘repeat’

Each file has the id numbers for all events that were originators and the id numbers for all their associated repeat events

1. Event_id – each record is a unique originator id
2. Repeat_event_ids – ids of repeat events separated by pipe

Note: ArcMap reads pipe as NULL
Part 2: Using output from CPPC

• Number of preventable near repeats
• Proportion of all burglaries that are near repeats
• Geographic concentration in the locations of near repeats

QUESTIONS?
Where to deploy crime prevention resources targeting near repeat burglary?

PHILADELPHIA EXAMPLE

POP/NR Analysis Framework

- Identify where near repeat problems exist
- Near Repeat Calculator to identify global patterns
- Near Repeat Crime Prevention Potential tool to explore local variability
- Develop an intervention
- Respond to NR pattern using NRAIT
- Run as an RCT if desired
- Use output from NRAIT to assess effect
- Conduct additional statistical analyses
Part 3: Analyzing near repeat crime

1. Calculate global near repeat patterns

Calculating Global Risk

- Near repeat calculator
  - Over what space-time windows does a statistically significant near repeat pattern exist?
Calculating Global Risk - Example

- Baltimore County, MD
  - Significant space-time risk
  - Near repeat pattern exists

<table>
<thead>
<tr>
<th></th>
<th>0-7 Days</th>
<th>8-14 Days</th>
<th>15-21 Days</th>
<th>22-28 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same location</td>
<td>5.18</td>
<td>1.58</td>
<td>0.00</td>
<td>8.14</td>
</tr>
<tr>
<td>1 to 400 ft.</td>
<td>4.46</td>
<td>1.55</td>
<td>1.24</td>
<td>1.09</td>
</tr>
<tr>
<td>401 to 800 ft.</td>
<td>1.64</td>
<td>2.12</td>
<td>1.17</td>
<td>1.30</td>
</tr>
<tr>
<td>801 to 1200 ft.</td>
<td>2.17</td>
<td>1.57</td>
<td>1.07</td>
<td>1.31</td>
</tr>
<tr>
<td>1201 to 1600 ft.</td>
<td>1.27</td>
<td>1.40</td>
<td>1.31</td>
<td>0.77</td>
</tr>
</tbody>
</table>

Part 2: Concentration - Philadelphia

![Number of Originators vs Number of NR events graph]

Number of Originators

Number of NR events

1  2  3  4  5  6  7
0  100 200 300 400 500 600
Part 2: Examine burglary across police units

- Total burglary
- Proportion of burglary problem that is involves preventable near repeats

Part 2: Philadelphia, by District

High prevalence of burglary AND high rate of NR

Low prevalence of burglary AND low rate of NR
Part 2: NR-CPP- Mapping

• Add the Excel file into your ArcMap session
• Join the information from NRCPC to your shp file
  • Identify the originators (Originator_ID)
  • Identify the repeats (Repeat_ID)
• Visually display the pattern of each
• Use the hot spot tool to discover where there are concentrations of near repeat events.

*These are the areas to focus NR prevention efforts*

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Part 2: NR-CPP- Geographic concentration
Part 2: Geographic concentration

• Within district variation in near repeat concentration
QUESTIONS?

Take away points

• Residential burglary CPP varies by city
• CPP should be integrated into analysis process
  • Calculate crime prevention potential prior to designing intervention
  • Examine length of patterns
  • Drill down the cone of resolution to identify ‘where’
• Quantify crime problem
  • Should we undertake this intervention?
  • Was the intervention successful?
• May be relevant for other crime types
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