Investigating Routine Activity Dynamics by Simulation Methods

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Outline

- Research goal
- Simulation structure
- Modeling language
- Simulation results
- Conclusions and future work

Dynamics of routine activity theory

- Routine Activity Theory:
  an offense occurs when a motivated offender meets a suitable target without a capable guardian being present

- So far so good but what about the dynamics when:
  * offenders react on target availability?
  * offenders react on guardians being present?
  * when guardians react on offenders moving around?
  * when guardians react on the reputation of targets?

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  * when guardians react on offenders moving around?
  * when guardians react on the reputation of targets?

- Computer simulation is the solution!

Main research goal

Focus: static targets (e.g. burglary)

How are the crime rates influenced by:

* target attraction values?
  (e.g., random distribution vs. rich areas)
* offender characteristics?
  (e.g., different thresholds to perform crime)
* guardian policies?
  (e.g., random patrolling vs. hot spot policing)

Structure of our simulation

'residential burglary case'

Graph of 25 targets, for example houses in a neighborhood or a small village. Some of the targets have 2 neighbors, some 3 or 4.

A	B	C	D	E
F	G	H	I	J
K	L	M	N	O
P	Q	R	S	T
U	V	W	X	Y

Type of agent: offender

have an attraction threshold

burglary if location is attractive and no guardian is present

high chance to move to most attractive neighbor

	A	
B		C
	D	

attractiveness	probability to go there
A=2	2/20 = 0.1
B=4	4/20 = 0.2
C=6	6/20 = 0.3
D=8	8/20 = 0.4

Type of agent: guardian 1

"random surveillance mode"

move randomly to a neighboring location

	A	
B		C
	D	

	probability to go there
A	0.25
B	0.25
C	0.25
D	0.25

Type of agent: guardian 2

"hot spot policing"

high chance to move to most victimized neighbor

victimization reputation:
victimized → reputation increased by 1
not victimized → reputation decreased by -0.5

	A	
B		C
	D	

victimized	probability to go there
A=1	1/20 = 0.05
B=4	4/20 = 0.2
C=7	7/20 = 0.35
D=8	8/20 = 0.4

Type of agent: guardian 3

"hot spot policing in areas"

same characteristics as guardians of type 2

allocated to certain (non-overlapping) areas

A	B	C	D	E
F	G	H	I	J
K	L	M	N	O
P	Q	R	S	T
U	V	W	X	Y

Modeling Language LEADSTO

Basic primitives: LEADSTO rules

$\alpha \rightarrow\rightarrow_{e, f, g, h} \beta$

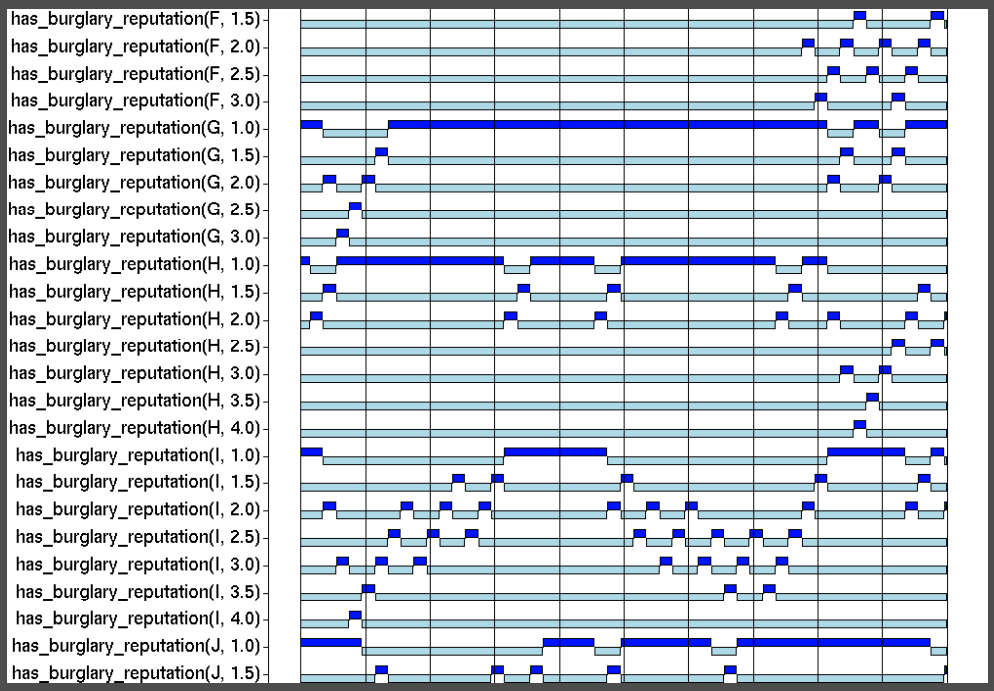
If state property α holds for a time interval with duration g
then after some delay (between e and f) state property β holds for a time interval with duration h

Example LEADSTO rules

"If an offender is at an attractive location without a guardian being present, he will break in"

$\forall$a1:agent $\forall$l:location
observes(a1, agent_of_type_at_location(a1, offender, l)) $\wedge$
has_preference_threshold(a1, x) $\wedge$
has_attractiveness(l, y) $\wedge$
x<y $\wedge$
$\forall$a2:agent not observes(a1, agent_of_type_at_location(a2, guardian, l))
$\rightarrow\rightarrow$ performs(burglary(a1, l)) $\wedge$ burglary_at(l)

Screenshot Simulation Trace



Targets simulation experiment 1

Each of the targets has its own attractiveness value.

A1	B2	C3	D4	E5
F6	G7	H8	I9	J10
K1	L2	M3	N4	O5
P6	Q7	R8	S9	T10
U1	V2	W3	X4	Y5

Experimental Design

- 21 situations

Per situation:

- different number of guardians
- different type of guardian
- not two types of guardians in one situation
- 100 traces

Results – experiment 1

	guardians	type	average number of burglaries over 100 traces
situation 1	2	1	109,34
situation 2	2	2	101,61
situation 3	2	3	102,78
situation 4	3	1	104,68
situation 5	3	2	95,12
situation 6	3	3	95,32
situation 7	4	1	100,75
situation 8	4	2	90,97
situation 9	4	3	91,69
situation 10	5	1	94,67
situation 11	5	2	86,67
situation 12	5	3	86,01
situation 13	6	1	90,80
situation 14	6	2	81,16
situation 15	6	3	79,27
situation 16	10	1	72,05
situation 17	10	2	65,15
situation 18	10	3	63,31
situation 19	20	1	50,87
situation 20	20	2	45,75
situation 21	20	3	47,37

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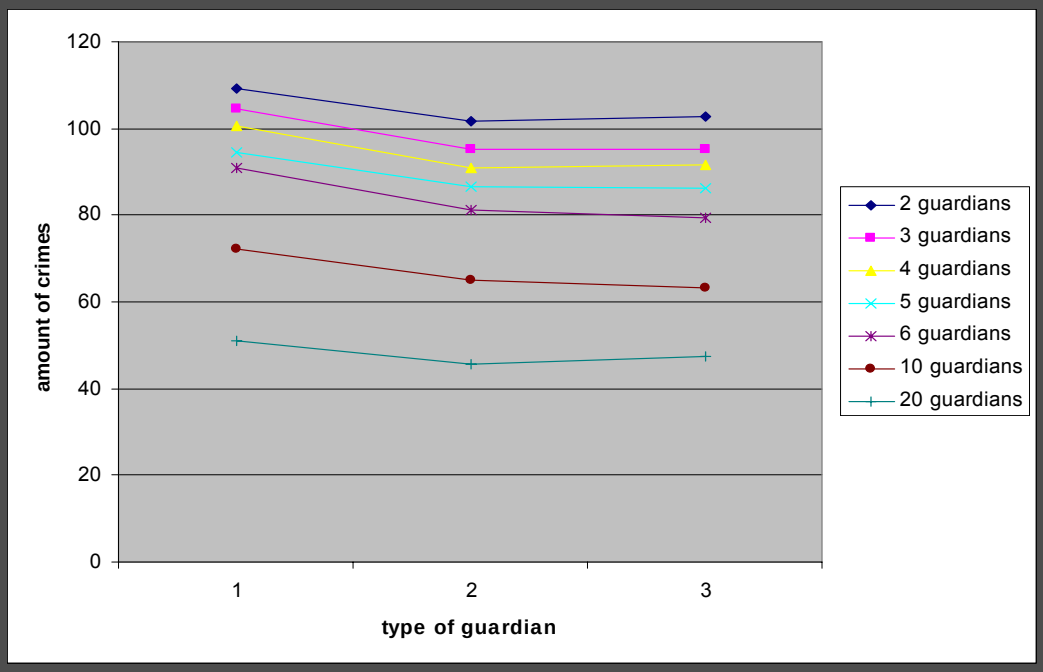
Results graphically



Results mean …

- Hot spot surveillance is a bit better than random surveillance (until you swamp society with police)
- Area hot spot surveillance policing is just as efficient as complete hot spot surveillance
- That is, in this –now still much too restricted- set of simulations with their set of parameters

Experiment 2

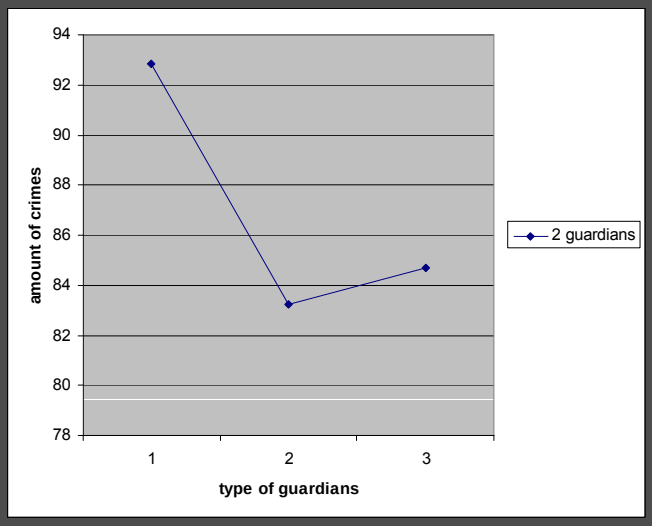
- Adjustment of the values of the targets
- Imposing a spatial structure on attraction values
- Creating the illusion of rings in a city, that become less and less attractive moving away from A

Targets simulation experiment 2

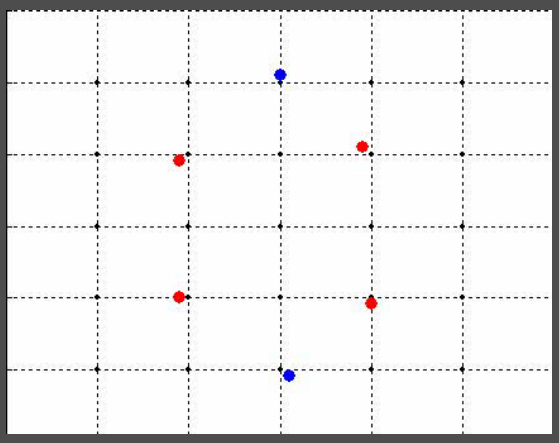
A10	B8	C6	D4	E2
F8	G8	H6	I4	J2
K6	L6	M6	N4	O2
P4	Q4	R4	S4	T2
U2	V2	W2	X2	Y2

Results graphically

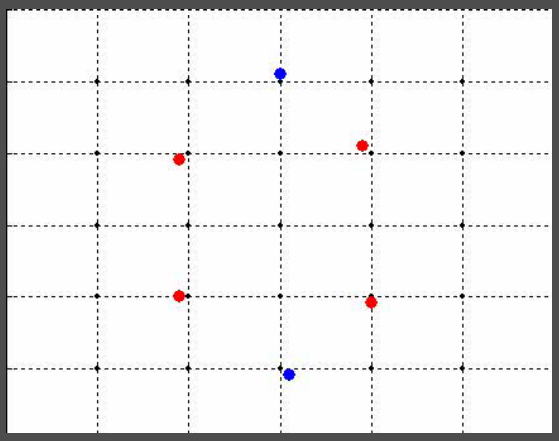
‘Ring society’



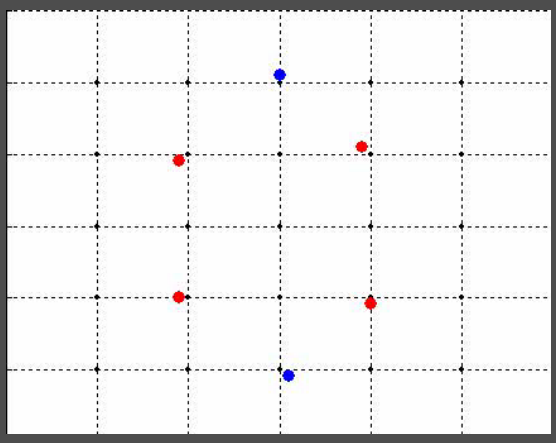
Clip guardian type 1



Clip guardian type 2



Clip guardian type 3



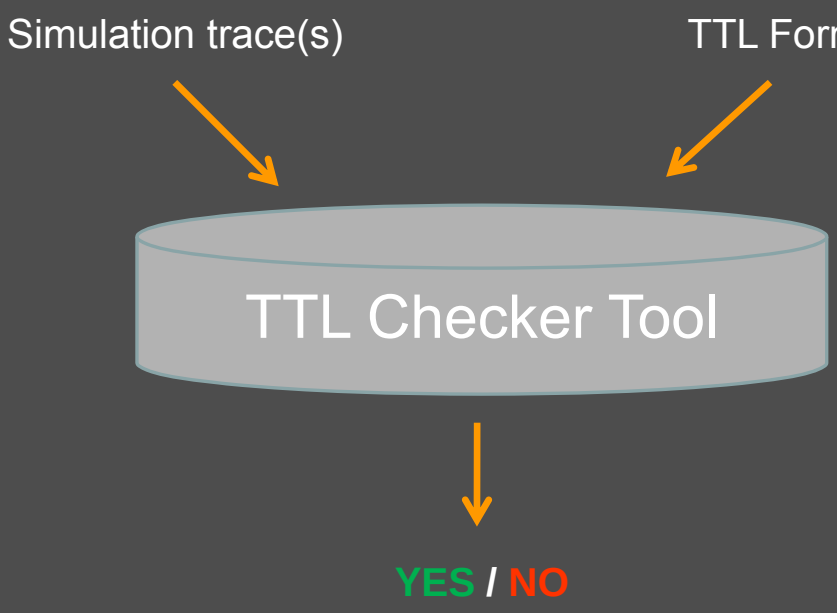
Results mean …

- Basically same results: hot spot surveillance is again better than random surveillance in this segregated (qua target value) society
- Area hot spot surveillance policing seems to be slightly worse than complete hot spot surveillance!
- However, more experiments are needed….

Automated Analysis

- Problem: large number of simulations
- Impossible to analyze all by hand
- Solution: automated analysis
- TTL checker tool

TTL Checker Tool



Future work

- More experiments with different parameter settings
- Different environments (e.g., 2 areas with 1 connection?)
- Enlarge society
- Introduce informal guardians
- Introduce anticipating guardians
- Introduce learning criminals
- …

Other Projects

- Influence of Biological and Psychological Aspects on Violence
- Social Learning of Crime within a Class Room
- Displacement of Crime; focus on hot spots and reputation
- Suggestions?

Contact Information

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