Table 9.1. Association between annual youth homicides and levels of shots fired in census tracts in Pittsburgh, 1990-1995.

Year	Youth Homicides	Number of Tracts by Annual Level of Shots Fired†			χ^2 ††
		Low	*Medium*	*High*	
1990	*None*	135	17	1	17.15
	At least One	12	7	2	
1991	*None*	128	24	1	25.78
	At least One	11	6	4	
1992	*None*	108	29	9	20.97
	At least One	8	13	6	
1993	*None*	85	43	4	59.75
	At least One	7	16	20	
1994	*None*	94	44	3	71.95
	At least One	6	9	18	
1995	*None*	99	47	2	43.46
	At least One	8	9	9	

† Low tracts have no more than one shot fired call monthly (<12 annually), medium tracts about one weekly (< 55 annually), and high tracts more than one weekly (≥ 59 annually).

†† χ^2 (2 degrees of freedom) are all statistically significant at better than .0001 level.

Table 9.2. Distribution of youth gangs and most active drug markets over Pittsburgh census tracts in 1993. †

		Highly Active Drug Markets		
		No	*Yes*	**Total**
Youth Gangs	*No*	139	2	141
	Yes	20	13	33
	Total	159	15	174
		χ^2	(df, p-value)	48.96 (1, <.0001)

† Annual totals are 33 tracts with youth gangs and 15 tracts with highly active drug markets. A total of 37 tracts have either in any of the six years.

Table 9.3. Dynamics of change in spatial distribution of shots fired rates over successive observations.

			Year-to-Year Change in *Local-Neighbor* Pairs	
Direction of Change	**Type of Diffusion**	**Mechanism of Change**	*Local is Diffusion Outcome*	*Local is Diffusion Source*
Changes from Low to High Levels	*Contagious*	Expansion Among Neighbors	LH to HH	HL to HH
		Relocation Among Neighbors	LH to HL	HL to LH
	Hierarchical	Isolated Increase	LL to HL	LL to LH
		Global Increase	LL to HH	LL to HH
Changes from High to Low Levels	*Contagious*	Expansion Among Neighbors	HL to LL	LH to LL
		Relocation Among Neighbors	HL to LH	LH to HL
	Hierarchical	Isolated Decrease	HH to LH	HH to HL
		Global Decrease	HH to LL	HH to LL
No Change	*None*	Stationary		

Table 9.4. Possible transitions over time in local neighbor pairs: local area is outcome of diffusion.

Local-Neighbor Pairs at Time t	**"Significant" Change in Local-Neighbor Pairs at t+1**				**Changes Not "Significant" at t+1**	**Total**	**Total Excluding Stationary Diagonals**
	LL	*HL*	*LH*	*HH*			
LL	N_{11} Stationary	**N_{12} Hierarchical Isolated Increase**	N_{13}	**N_{14} Hierarchical Global Increase**	N_{15} Small Changes from LL to HL, LH, or HH	$N_{1.}$ $\sum_{j=1}^{5} N_{1j}$	$N_{1.}$-N_{11}
HL	**N_{21} Contagious Expansion in Local**	N_{22} Stationary	**N_{23} Contagious Relocation in Local**	N_{24}	N_{25} Small Changes from HL to LL, LH, or HH	$N_{2.}$ $\sum_{j=1}^{5} N_{2j}$	$N_{2.} - N_{22}$
LH	N_{31}	**N_{32} Contagious Relocation in Local**	N_{33} Stationary	**N_{34} Contagious Expansion in Local**	N_{15} Small Changes from LH to LL, HL, or HH	$N_{3.}$ $\sum_{j=1}^{5} N_{3j}$	$N_{3.} - N_{33}$
HH	**N_{41} Hierarchical Global Decrease**	N_{42}	**N_{43} Hierarchical Isolated Decrease**	N_{44} Stationary	N_{45} Small Changes from HH to LL, HL, or LH	$N_{4.}$ $\sum_{j=1}^{5} N_{4j}$	$N_{4.} - N_{44}$
Total	$N_{.1}$ $\sum_{i=1}^{4} N_{i1}$	$N_{.2}$ $\sum_{i=1}^{4} N_{i2}$	$N_{.3}$ $\sum_{i=1}^{4} N_{i3}$	$N_{.4}$ $\sum_{i=1}^{4} N_{i4}$	$N_{.5}$ $\sum_{i=1}^{4} N_{i5}$	$N_{..}$ $\sum_{i=1}^{4}\sum_{j=1}^{5} N_{ij}$	$N_{..}$-N_{11}-N_{22}-N_{33}-N_{44}
Total Excluding Stationary Diagonals	$N_{.1}$-N_{11}	$N_{.2}$-N_{22}	$N_{.3}$-N_{33}	$N_{.4}$-N_{44}	$N_{.5}$	$N_{..}$-N_{11}-N_{22}-N_{33}-N_{44}	

Note: Diffusion transitions to increased local rates are displayed as white on black; those to decreased rates are black on gray.

Table 9.5. Possible transitions over time in local neighbor pairs: local area is source of diffusion.

Local-Neighbor Pairs at Time t	**"Significant" Change in Local-Neighbor Pairs at t+1**				**Changes Not "Significant" at t+1**	**Total**	**Total Excluding Stationary Diagonals**
	LL	*HL*	*LH*	*HH*			
LL	N_{11} Stationary	N_{12}	N_{13} Hierarchical Isolated Increase	N_{14} Hierarchical Global Increase	N_{15} Small Changes from LL to HL, LH, or HH	$N_{1.}$ $\sum_{j=1}^{5} N_{1j}$	$N_{1.}$-N_{11}
HL	N_{21}	N_{22} Stationary	**N_{23} Contagious Relocation in Local**	**N_{24} Contagious Expansion in Neighbors**	N_{25} Small Changes from HL to LL, LH, or HH	$N_{2.}$ $\sum_{j=1}^{5} N_{2j}$	$N_{2.} - N_{22}$
LH	**N_{31} Contagious Expansion in Neighbors**	**N_{32} Contagious Relocation in Neighbor**	N_{33} Stationary	N_{34}	N_{15} Small Changes from LH to LL, HL, or HH	$N_{3.}$ $\sum_{j=1}^{5} N_{3j}$	$N_{3.} - N_{33}$
HH	**N_{41} Hierarchical Global Decrease**	**N_{42} Hierarchical Isolated Decrease**	N_{43}	N_{44} Stationary	N_{45} Small Changes from HH to LL, HL, or LH	$N_{4.}$ $\sum_{j=1}^{5} N_{4j}$	$N_{4.} - N_{44}$
Total	$N_{.1}$ $\sum_{i=1}^{4} N_{i1}$	$N_{.2}$ $\sum_{i=1}^{4} N_{i2}$	$N_{.3}$ $\sum_{i=1}^{4} N_{i3}$	$N_{.4}$ $\sum_{i=1}^{4} N_{i4}$	$N_{.5}$ $\sum_{i=1}^{4} N_{i5}$	$N_{..}$ $\sum_{i=1}^{4}\sum_{j=1}^{5} N_{ij}$	$N_{..}$-N_{11}-N_{22}-N_{33}-N_{44}
Total Excluding Stationary Diagonals	$N_{.1}$-N_{11}	$N_{.2}$-N_{22}	$N_{.3}$-N_{33}	$N_{.4}$-N_{44}	$N_{.5}$	$N_{..}$-N_{11}-N_{22}-N_{33}-N_{44}	

Note: Diffusion transitions to increased neighbor rates are displayed as white on black; those to decreased rates are black on gray.

Table 9.6. Calculation of diffusion and comparison transition rates in local neighbor pairs[†].

Diffusion Type [††]	Change in Local-Neighbor Pair	Diffusion Rate	Comparison Rate [†††]
A. Local Area is Outcome of Diffusion: Effect of Neighbor Level at t on Local Level at t+1			
Hierarchical: Isolated or Global Increases	L_tL_t to $H_{t+1}L_{t+1}$ or $H_{t+1}H_{t+1}$	$\frac{N_{12}+N_{14}}{N_{1.}-N_{11}}$	$\frac{N_{32}+N_{42}+N_{24}+N_{34}}{N^{*}_{..}-(N_{1.}-N_{11})}$
Contagious: Expansion or Relocation Increases	L_tH_t to $H_{t+1}L_{t+1}$ or $H_{t+1}H_{t+1}$	$\frac{N_{32}+N_{34}}{N_{3.}-N_{33}}$	$\frac{N_{12}+N_{42}+N_{14}+N_{24}}{N^{*}_{..}-(N_{3.}-N_{33})}$
Contagious: Expansion or Relocation Decreases	H_tL_t to $L_{t+1}L_{t+1}$ or $L_{t+1}H_{t+1}$	$\frac{N_{21}+N_{23}}{N_{2.}-N_{22}}$	$\frac{N_{13}+N_{43}+N_{31}+N_{41}}{N^{*}_{..}-(N_{2.}-N_{22})}$
Hierarchical: Isolated or Global Decreases	H_tH_t to $L_{t+1}L_{t+1}$ or $L_{t+1}H_{t+1}$	$\frac{N_{41}+N_{43}}{N_{4.}-N_{44}}$	$\frac{N_{13}+N_{23}+N_{21}+N_{31}}{N^{*}_{..}-(N_{4.}-N_{44})}$
B. Local Area is Source of Diffusion: Effect of Local Level at t on Neighbor Level at t+1			
Hierarchical: Isolated or Global Increases	L_tL_t to $L_{t+1}H_{t+1}$ or $H_{t+1}H_{t+1}$	$\frac{N_{13}+N_{14}}{N_{1.}-N_{11}}$	$\frac{N_{23}+N_{43}+N_{24}+N_{34}}{N^{*}_{..}-(N_{1.}-N_{11})}$
Contagious: Expansion or Relocation Increases	H_tL_t to $L_{t+1}H_{t+1}$ or $H_{t+1}H_{t+1}$	$\frac{N_{23}+N_{24}}{N_{2.}-N_{22}}$	$\frac{N_{13}+N_{43}+N_{14}+N_{34}}{N^{*}_{..}-(N_{2.}-N_{22})}$
Contagious: Expansion or Relocation Decreases	L_tH_t to $L_{t+1}L_{t+1}$ or $H_{t+1}L_{t+1}$	$\frac{N_{31}+N_{32}}{N_{3.}-N_{33}}$	$\frac{N_{12}+N_{42}+N_{21}+N_{41}}{N^{*}_{..}-(N_{3.}-N_{33})}$
Hierarchical: Isolated or Global Decreases	H_tH_t to $L_{t+1}L_{t+1}$ or $H_{t+1}L_{t+1}$	$\frac{N_{41}+N_{42}}{N_{4.}-N_{44}}$	$\frac{N_{12}+N_{32}+N_{21}+N_{31}}{N^{*}_{..}-(N_{4.}-N_{44})}$

† N_{ij} is the number of transitions from state i at time t to state j at time t+1. See Tables 4 or 5 for N_{ij} designations in each transition.

†† To avoid instability problems that can arise from small Ns, we continue to distinguish the direction of diffusion (i.e., increasing or decreasing rates), but ortherwise combine the alternative types of contagious diffusion together, and the alternative types of hierarchical diffusion together.

††† $N^{*}_{..} = \sum_i \sum_j N_{ij} - N_{11} - N_{22} - N_{33} - N_{44}$

Table 9.7. Counts of quarterly transitions in local-neighbor pairs of shots fired incidents for census tracts in Pittsburgh from 1990 to 1995: cross quarter effects.

Local-Neighbor Pairs at time t	"Significant" Changes in Local-Neighbor Pairs at time t+1				Changes Not Significant at time t+1	Total	Percent Stationary from t to t+1	Total Excluding Stationary Diagonals
	LL	*HL*	*LH*	*HH*				
LL	1457	9	12	6	412	1896	76.8	439
HL	4	309	5	12	223	553	55.9	244
LH	7	4	630	18	321	980	64.3	350
HH	4	8	16	338	207	573	59.0	235
Total	1472	330	663	374	1163	4002	---	1268
Total Excluding Stationary Diagonals	15	21	33	36	1163	1268	---	---

Table 9.8. Patterns of quarterly changes in local and neighbor tract shots fired rates in Pittsburgh from 1990 to 1995.

	Proportion of Tracts with "Substantial" Change in Shots Fired Rate in Successive Quarters†		
Diffusion Type	***Diffusion*** ††		***Other*** †††
Local Tract is Outcome of Diffusion:	*Effect Neighbor Rate at t on Local Rate at t+1*		
General Increases -- Spontaneous or Global (LL to HL, LL to HH)	.034 (439)		.051 (829)
Neighbor Effect Increases -- Expansion or Displacement (LH to HH, LH to HL)	.063 (350)	* ††††	.038 (918)
Neighbor Effect Decreases -- Suppression or Displacement (HL to LL, HL to LH)	.037 (244)		.038 (1024)
General Decreases -- Spontaneous or Global (HH to LH, HH to LL)	.085 (235)	** ††††	.027 (1033)
Local Tract is Source of Diffusion:	*Effect Local Rate at t on Neighbor Rate at t+1*		
General Increases -- Spontaneous or Global (LL to LH, LL to HH)	.041 (439)		.062 (829)
Neighbor Effect Increases -- Expansion or Displacement (HL to LH, HL to HH)	.070 (244)		.051 (1024)

continued…

Neighbor Effect Decreases -- Suppression or Displacement (LH to HL, LH to LL)	.031 (350)		.027 (918)
General Decreases -- Spontaneous or Global (HH to HL, HH to LL)	.051 (235)	* ††††	.023 (1033)

† The transition rates reported in this table exclude completely all stationary transitions that result in *no change* in local-neighbor pairs. The proportion stationary in each type of local-neighbor pair exceeds one-half (see Table 9.7). The number of tracts eligible for each type of transition is noted in parentheses. A change in rates for a tract is "substantial" if the Euclidian distance between the local-neighbor pair of rates at time t+1 is more than 2 standard units away from the local-neighbor pair of rates at time t.

†† Transitions involving diffusion are described in the first column of the table. For example, in the analysis of outcome effects, contagious diffusion that increases local rates for shots fired calls involves transitions from LH local-neighbor pairs in year t to either HL or HH pairs in year t+1. Alternatively, in the analysis of source effects, contagious diffusion that increases neighbor rates for shots fired calls involves transitions from HL local-neighbor pairs in year t to either LH or HH pairs in year t+1.

††† The comparison group of "other" transitions includes all other "significant" non-stationary transitions to the same destination local-neighbor pair. For example, in the case of outcome effects associated with contagious increases in local shots fired rates, "other" transitions include all "significant" non-stationary changes from LL, HL, and HH at time t to HL or HH at time t+1. The individual counts that are the basis for the reported transition rates are in Table 9.7.

†††† Table reports results of one-tail test that diffusion transition rates are larger than other transition rates. Significance levels in one-tail z test are: * $p<.05$, ** $p<.01$, and *** $p<.001$.