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Officer Features and Shooting Risk

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Zimring's Decision Points Intersect with Environment, Organization, and Situation

Decision point	Environmental	Organizational	Situational
Whether to shoot			
How many rounds			
What medical care			
Whether to transport			

Focus on Role of Officer Features in Shooting Risk and Rate

Decision point	Environmental	Organizational	Situational
Whether to shoot			Ridgeway (2016)
How many rounds			Ridgeway, Cave, Grieco (under review)
What medical care			
Whether to transport			

Confounding Chronically Hindered Connecting Officer Features and Risk

"the overrepresentation of minority officers among police shooters [is] closely associated with racially varying pattern of assignment, socialization, and residence"

Fyfe (1981)

Confounding Chronically Hindered Connecting Officer Features and Risk

"black officers are not prominent in the units of the Police Department which see the most shooting action"

Geller & Karales (1981)

Confounding Chronically Hindered Connecting Officer Features and Risk

"blacks were posted to high-risk assignments far more often than whites"

the age/shooting risk relationship is "an artifact of age-related variations in assignment and in exposure to potential shooting situations"

Fyfe (1988)

Confounding Chronically Hindered Connecting Officer Features and Risk

"If, for example, black officers draw more complaints, is that because they act more aggressively, or because they are assigned to tougher beats…"

Sklansky (2006)

Confounding Chronically Hindered Connecting Officer Features and Risk

"it is quite possible that other factors, such as the extent to which college-educated officers versus non-college-educated officers encounter resistant suspects, may account for why education appears to matter"

Paoline and Terrill (2007)

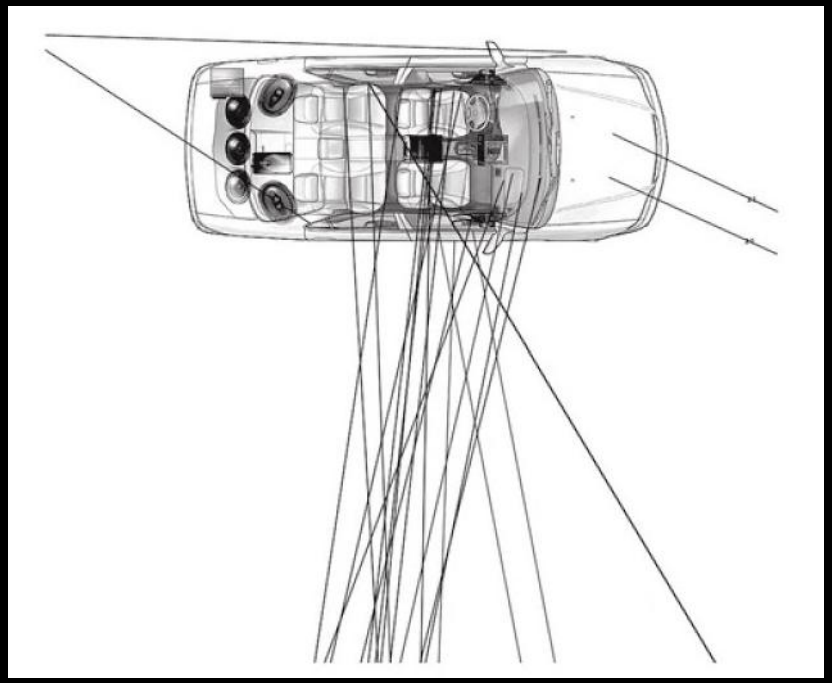
Confounding Chronically Hindered Connecting Officer Features and Risk

"based on an officer's rank, time on the job, age, and gender, he or she may have been less active, assigned to areas with lower crime rates, or working in a position that did not have frequent contact with citizens"

McElvain and Kposowa (2008)

Officer Van Dyke Fired 16 Rounds
Officer Walsh Holstered His Firearm

Five Officers Discharged 50 Rounds, Killing Sean Bell in 2006



- Detective Oliver, age 35, white, 31 rounds
- Detective Isnora, age 28, black, 11 rounds
- Detective Cooper, age 39, black, 4 rounds
- Officer Carey, age 26, white, 3 rounds
- Detective Headley, age 35, black, 1 round

Matching Officers on the Same Shooting Scene Eliminates Sources of Confounding

- Laquan McDonald shooting
  - No confounding by assignment or opportunity
  - On the same scene, facing the same subject, operating in the same organization and environment
  - Differ in their own features and chance variation in space and positioning
- Sean Bell shooting
  - Surrounding the same vehicle, in the same neighborhood, at the same time

Model the Chance of Shooting

- Probability of shooting for an officer with features **x** in an environment with features **z**

$$\log \frac{P(\mathbf{x}, \mathbf{z})}{1 - P(\mathbf{x}, \mathbf{z})} = h(\mathbf{z}) + \beta' \mathbf{x}$$

- **z** includes suspect features, time, place, …
- *h*(**z**) is a large negative number for almost all environments
- **x** includes officer age, race, sex, prior involvement in shootings, complaints, awards, assignment, …
- $\exp(\beta_j)$ indicates how much a unit change in x_j increases the odds of the officer shooting

Model the Number of Rounds Fired

- Probability of shooting *r* rounds for an officer with features **x** in an environment with features **z**

$$\log P(R = r) = r(h(\mathbf{z}) + \beta'\mathbf{x}) - e^{h(\mathbf{z})+\beta'\mathbf{x}} - \log r!$$

- Poisson regression with shooting rate $e^{h(\mathbf{z})+\beta'\mathbf{x}}$
- $\exp(\beta_j)$ indicates how much a unit change in x_j multiplies the expected rounds discharged

Conditional Likelihood Provides Consistent Estimates from Shooting Data Alone

- Consider a shooting with *n* officers where $r_i = 1$ if officer *i* shot and 0 otherwise
- Traditional logistic regression would find β to maximize

$$P(R_1 = r_1, \ldots, R_n = r_n | \mathbf{x}_1, \ldots, \mathbf{x}_n, h(\mathbf{z}), \beta)$$

- Conditional likelihood conditions on the number of shooters

$$P(R_1 = r_1, \ldots, R_n = r_n | R_1 + \cdots + R_n = r_1 + \cdots + r_n, \mathbf{x}_1, \ldots, \mathbf{x}_n, h(\mathbf{z}), \beta)$$

Conditional Likelihood Does Not Use, Need, Involve $h(\mathbf{z})$

- For the decision to shoot, the contribution of a shooting to the conditional likelihood is

$$\frac{e^{r_1\beta'\mathbf{x}_1}\ldots e^{r_n\beta'\mathbf{x}_n}}{\sum_{\rho_i\in\{0,1\},\sum\rho_i=\sum r_i} e^{\rho_1\beta'\mathbf{x}_1}\ldots e^{\rho_n\beta'\mathbf{x}_n}}$$

- If no one shoots or everyone shoots, the incident provides no information
- Knowing or not knowing $h(\mathbf{z})$ produces the same $\hat{\beta}$
- Still yields consistent estimates for β (Manski & Lerman, 1977; Prentice & Pyke, 1979)

Conditional Likelihood Does Not Use, Need, Involve $h(\mathbf{z})$

- For the decision to shoot, the contribution of a shooting to the conditional likelihood is

$$\frac{e^{r_1\beta'\mathbf{x}_1}\cdots e^{r_n\beta'\mathbf{x}_n}}{\sum_{\rho_i\in\{0,1\},\sum\rho_i=\sum r_i} e^{\rho_1\beta'\mathbf{x}_1}\cdots e^{\rho_n\beta'\mathbf{x}_n}}$$

- For the number of rounds, the contribution of a shooting to the conditional likelihood is

$$\frac{e^{r_1\beta'\mathbf{x}_1}\cdots e^{r_n\beta'\mathbf{x}_n}}{\sum_{\sum\rho_i=\sum r_i} \frac{1}{\rho_1!\cdots\rho_n!} e^{\rho_1\beta'\mathbf{x}_1}\cdots e^{\rho_n\beta'\mathbf{x}_n}}$$

Two Nearly Identical Officers

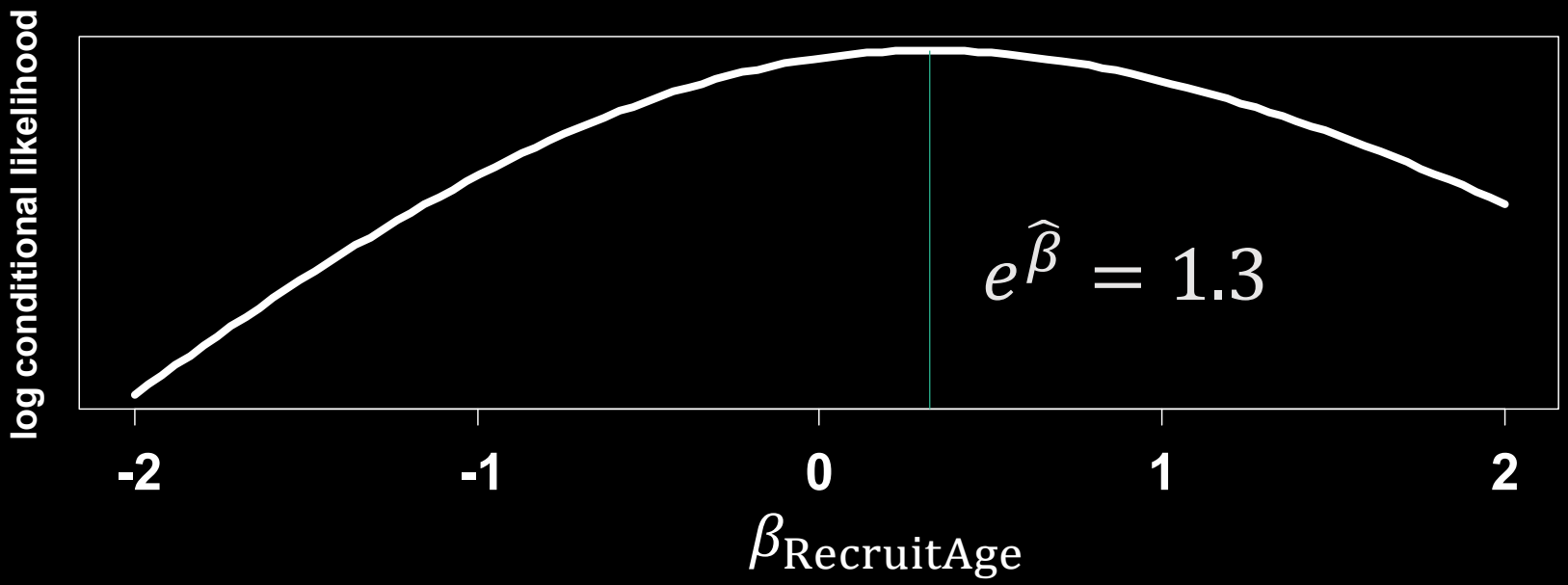
OIS ID	Rounds	Recruit age	Years on job	Sex	Race	Prior OIS #	Force complaints	Rank	Assign	Gun type	Caliber
2	3	24	4	Male	White	0	0	Off	Special	Pistol	9 mm
2	4	25	4	Male	White	0	0	Off	Special	Pistol	9 mm

- Identical on all features except recruit age
- Older officer shot one additional round, 1.3 times more than the younger officer

Example Shooting Only Has Information on Recruit Age

- Conditional likelihood simplifies to

$$\frac{1}{\sum_{\rho_2=1}^{6} \frac{1}{(7-\rho_2)!\,\rho_2!} \exp\left((\rho_2 - 4)\beta_{\text{RecruitAge}}\right)}$$



Utilized Data on a Review of Three Years of OIS Records

- All officer-involved shootings adjudicated in 2004, 2005, and 2006
- 106 incidents involving 150 shooting officers and 141 non-shooting officers
- Collected data on age, experience, education, training, and past performance

"The characteristics of officers involved in discharge incidents will be examined for patterns in training, experience, supervision, and other factors that may help predict, and thus reduce, firearms discharges generally and inappropriate discharges in particular"

Who Is More Likely to Shoot?

Variable	Risk difference
Rank	
Police officer (reference)	
Detective	
Sergeant	
Lieutenant	
Captain	

- If an OIS occurs and an officer at each of these ranks is on the scene, who is most likely to be the shooter?

Supervisors and Management Ranks Are Less Likely to Shoot

Variable	Risk difference
Rank	
Police officer (reference)	
Detective	No difference
Sergeant	-74%
Lieutenant	-95%
Captain	-96%

Who Is More Likely to Shoot?

Variable	Risk difference
Rank	
Police officer (reference)	
Detective	No difference
Sergeant	-74%
Lieutenant	-95%
Captain	-96%
Male	
Race	
White (reference)	
Black	
Hispanic	

Black Officers More Likely to Shoot

Variable	Risk difference
Rank	
Police officer (reference)	
Detective	No difference
Sergeant	-74%
Lieutenant	-95%
Captain	-96%
Male	No difference
Race	
White (reference)	
Black	+226%
Hispanic	No difference

Each Additional Year of Recruiting Age Decreases Risk by 11%

Variable	Risk difference
Rank	
Police officer (reference)	
Detective	No difference
Sergeant	-74%
Lieutenant	-95%
Captain	-96%
Male	No difference
Race	
White (reference)	
Black	+226%
Hispanic	No difference
Years at NYPD	No difference
Age when recruited	-11%
Education	No difference
Special assignment	No difference

Tracked Annual Activity

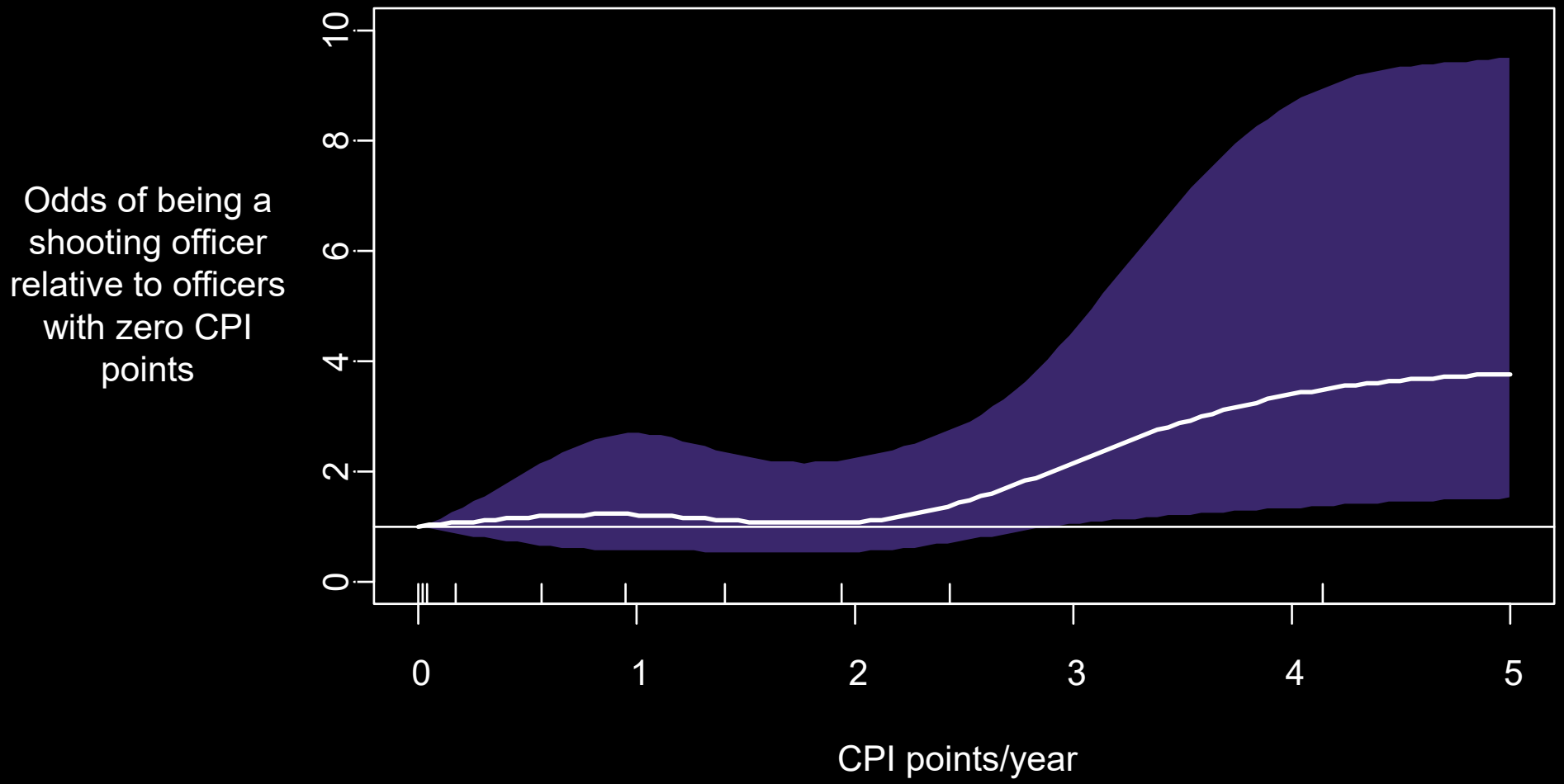
Variable	Risk difference
Average annual	
Evaluation score < 3.5	
Range score < 86	
Complaints > 0.6	
Medal count > 3.8	
CPI points > 3.1	
Gun arrests > 2.4	
Felony arrests > 9.3	
Misdemeanor arrests > 10.0	
Days of leave	

Rapid Accumulation of Negative Marks Signals Elevated Shooting Risk

Variable	Risk difference
Average annual	
Evaluation score < 3.5	
Range score < 86	
Complaints > 0.6	
Medal count > 3.8	
CPI points > 3.1	+212%
Gun arrests > 2.4	
Felony arrests > 9.3	
Misdemeanor arrests > 10.0	-80%
Days of leave	

8% of NYPD officers
15% of shooting scene officers

Exceeding 3.1 CPI/year Strongly Associated with Shooting Risk



Major Cities Chiefs (MCCA) and Police Foundation Standardized Collection

- 56 agencies from MCCA in the U.S. and Canada contributed to this data collection effort
- From 1 incident in one agency to 400+ in another
- Full dataset describes 2,574 officers involved in 1,600 shootings between 2010-2018
- Analysis used all 317 multi-officer shootings, 849 officers, 5,026 rounds
- Only included data on officers who discharged their firearm

No Effect of Age on Number of Rounds

Officer features	Rate ratio	Permutation 95% CI	Permutation p-value
Age at recruitment	1.01	(0.99, 1.02)	0.25
Years of experience	1.00	(0.98, 1.01)	0.62

No Effect of Sex or Race on Rounds Fired

Officer features	Rate ratio	Permutation 95% CI	Permutation p-value
Age at recruitment	1.01	(0.99, 1.02)	0.25
Years of experience	1.00	(0.98, 1.01)	0.62
Female	0.86	(0.63, 1.16)	0.31
Race (relative to white)			
Black	1.05	(0.86, 1.28)	0.62
Hispanic	1.09	(0.87, 1.36)	0.46
Other	0.76	(0.56, 1.03)	0.07

No Effect of Prior OIS or Complaints

Officer features	Rate ratio	Permutation 95% CI	Permutation p-value
Age at recruitment	1.01	(0.99, 1.02)	0.25
Years of experience	1.00	(0.98, 1.01)	0.62
Female	0.86	(0.63, 1.16)	0.31
Race (relative to white)			
Black	1.05	(0.86, 1.28)	0.62
Hispanic	1.09	(0.87, 1.36)	0.46
Other	0.76	(0.56, 1.03)	0.07
Prior OIS (relative to 0)			
1 or more	1.02	(0.77, 1.35)	0.90
2 or more	1.23	(0.88, 1.73)	0.21
Prior force complaint	1.25	(0.95, 1.64)	0.10

No Effect of Rank or Assignment

Officer features	Rate ratio	Permutation 95% CI	Permutation p-value
Age at recruitment	1.01	(0.99, 1.02)	0.25
Years of experience	1.00	(0.98, 1.01)	0.62
Female	0.86	(0.63, 1.16)	0.31
Race (relative to white)			
Black	1.05	(0.86, 1.28)	0.62
Hispanic	1.09	(0.87, 1.36)	0.46
Other	0.76	(0.56, 1.03)	0.07
Prior OIS (relative to 0)			
1 or more	1.02	(0.77, 1.35)	0.90
2 or more	1.23	(0.88, 1.73)	0.21
Prior force complaint	1.25	(0.95, 1.64)	0.10
Role			
Detective	1.09	(0.72, 1.64)	0.68
Sergeant or more senior	1.03	(0.82, 1.30)	0.81
Other	0.66	(0.34, 1.31)	0.23
Special assignment	1.28	(0.95, 1.72)	0.10

No Effect of Firearm Type

Officer features	Rate ratio	Permutation 95% CI	Permutation p-value
Age at recruitment	1.01	(0.99, 1.02)	0.25
Years of experience	1.00	(0.98, 1.01)	0.62
Female	0.86	(0.63, 1.16)	0.31
Race (relative to white)			
Black	1.05	(0.86, 1.28)	0.62
Hispanic	1.09	(0.87, 1.36)	0.46
Other	0.76	(0.56, 1.03)	0.07
Prior OIS (relative to 0)			
1 or more	1.02	(0.77, 1.35)	0.90
2 or more	1.23	(0.88, 1.73)	0.21
Prior force complaint	1.25	(0.95, 1.64)	0.10
Role			
Detective	1.09	(0.72, 1.64)	0.68
Sergeant or more senior	1.03	(0.82, 1.30)	0.81
Other	0.66	(0.34, 1.31)	0.23
Special assignment	1.28	(0.95, 1.72)	0.10
Long gun (relative to pistol)	1.01	(0.78, 1.30)	0.97

Few Incidents Provide Information

Officer features	Rate ratio	Permutation 95% CI	Permutation p-value	Shootings with info
Age at recruitment	1.01	(0.99, 1.02)	0.25	272
Years of experience	1.00	(0.98, 1.01)	0.62	277
Female	0.86	(0.63, 1.16)	0.31	36
Race (relative to white)				
Black	1.05	(0.86, 1.28)	0.62	49
Hispanic	1.09	(0.87, 1.36)	0.46	73
Other	0.76	(0.56, 1.03)	0.07	35
Prior OIS (relative to 0)				
1 or more	1.02	(0.77, 1.35)	0.90	86
2 or more	1.23	(0.88, 1.73)	0.21	30
Prior force complaint	1.25	(0.95, 1.64)	0.10	40
Role				
Detective	1.09	(0.72, 1.64)	0.68	21
Sergeant or more senior	1.03	(0.82, 1.30)	0.81	67
Other	0.66	(0.34, 1.31)	0.23	9
Special assignment	1.28	(0.95, 1.72)	0.10	40
Long gun (relative to pistol)	1.01	(0.78, 1.30)	0.97	54

Effective Conditional Likelihood Depends on Data Collection

1. Amass sufficient data
   - A third of shootings involve multiple officers
   - 4% of shootings had information for the relationship between prior force complaints and shooting risk
2. Standardize reporting
3. Document the presence of non-shooting officers
   - New Chicago PD consent decree requires documenting all “CPD units identified in the incident report as being on the scene of the use of force incident”

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Central Personnel Index Assign Points to Problematic Incidents

Event	Point value
Suspension	8
Loss of firearm	6
Negative evaluation - A	5
Fail to safeguard weapon	5
Chronic sick – B	4
Loss of shield	4
Negative evaluation – B	3
Chronic sick – A	2
Firearm discharge	1
Dept. auto accident	1