Universal Patterns in Modern Conflicts

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There are many people involved in this research:

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Is there a common structure of modern warfare that remains more or less constant across diverse wars?

Aside from the inherent interest of this question, the answer can have important implications for the practical conduct of war, including medical and insurance planning.

What is the relationship between terrorism and modern warfare?

The distinction between the two is often blurred, e.g., in the concept of the “war on global terrorism”. But there does appear to be a real relationship between the two and knowledge of its nature will be very welcome.
We find remarkable regularities and similarities in the size distribution of violent events in large number of modern conflicts: Colombia, Iraq, Afghanistan, Indonesia, Peru, Israel-Palestine, Northern Ireland, Casamance (Senegal), Sierra Leone, Uganda and El Salvador.

We organize and explain these findings for modern conflicts with a model of the coalescence and fragmentation of insurgent groups.

One can learn about the nature of an insurgency from studying the size distribution of casualties that it throws up.
Our findings greatly resemble those of Clauset, Young and Gleiditsch (2007) on the size distribution of casualties in terrorist attacks.

The links between terrorism and insurgency deserve deeper study.
We also find striking similarities in the timing of violent events across four modern conflicts: Colombia, Iraq, Afghanistan and Peru.

It seems that there are common and predictable patterns to the way that humans wage war that transcends particularities of time and place.
Common Patterns in Insurgency

\[ P(X \geq x) = K x^{-(\alpha - 1)} \]

\[ \Rightarrow p(x) = C x^{-\alpha} \]

\[ \alpha = 2.3 \]

\[ x_{\text{min}} = 8 \]

use max. likelihood + Kolmogorov-Smirnov

http://xxx.lanl.gov/abs/physics/0605035
Variation through time using a sliding time-window

Non-G7 Terrorism

G7 Terrorism

Power-law slope $\alpha$

Colombia

Iraq

http://xxx.lanl.gov/abs/physics/0605035
Variation of the Frequency of Fatal Quarrels With Magnitude

Lewis F. Richardson

Log-Log plots of 1 – the Cumulative Distribution Function for Severity of Events for Afghanistan

$\alpha_{ML} = 2.4477$

$x_{min} = 8$
Log-Log plots of 1 – the Cumulative Distribution Function for Severity of Events for Indonesia (separatist)

\( P(X \geq x) \)  

Severity of event, \( x \) - Number of people killed

\( \alpha_{ML} = 2.5027 \)

\( x_{\text{min}} = 5 \)
Log-Log plots of 1 – the Cumulative Distribution Function for Severity of Events for Israel-Palestine Conflict

\[ \alpha_{ML} = 2.1448 \]

\[ x_{min} = 3 \]
Log-Log plots of $1 - \text{the Cumulative Distribution Function for Severity of Events for Northern Ireland}$
Database: EL SALVADOR
Variable: rkill + skill
Xmin: 20
Alpha: 2.39
Log-Log Plots for $1 - \text{the Cumulative Distribution Function for the Severity of Events in Peru}$
Database: UGANDA
Variable: Effects-Total Killed
Xmin: 5
Alpha: 2.71
Log-Log plots of $1 -$ the Cumulative Distribution Function for Severity of Events for US civil war

$P(X \geq x)$

Severity of event, $x$ - Number of people killed plus injured

$\alpha_{ML} = 1.7518$

$x_{\text{min}} = 360$
Log-Log plots of $1 - \text{the Cumulative Distribution Function for}
\text{Severity of Events for Spanish civil war}$

$P(X \geq x)$

Severity of event, $x$ - Number of people killed plus injured

$x_{\text{min}} = 390$

$\gamma_{\text{ML}} = 1.6996$
Log-Log plots of 1 – the Cumulative Distribution Function for Severity of Events for Russian civil war

$P(X \geq x)$

Severity of event, $x$ - Estimated number of victims

$\alpha_{ML} = 1.9501$

$x_{min} = 344$
Log-Log plots of 1 – the Cumulative Distribution Function for Severity of Events for Rwanda-Genocide

\[ P(X \geq x) \]

Severity of event, \( x \) - Estimated number of victims

\[ \alpha_{ML} = 2.1389 \]

\[ x_{min} = 12199 \]
Log-Log plots of 1 – the Theoretical Cumulative Distribution Function for Severity of Events for old wars and new wars (without Iterate)
\[ \frac{\partial n_s}{\partial t} = -\frac{v s n_s}{N} + \frac{(1 - v)}{N^2} \sum_{s' = 1}^{s-1} s' n_{s'} (s - s') n_{s-s'} + \frac{2(1 - v) s n_s}{N^2} \sum_{s' = 1}^{\infty} s' n_{s'} , \text{ for } s \geq 2 \]

\[ \frac{\partial n_1}{\partial t} = \frac{v}{N} \sum_{s' = 2}^{\infty} (s')^2 n_{s'} - \frac{2(1 - v) n_1}{N^2} \sum_{s' = 1}^{\infty} s' n_{s'} . \]

\[ n_{s=1} = 1 \]
\[ n_{s=2} = 1 \]
\[ n_{s=3} = 2 \]
\[ n_{s=6} = 1 \]

http://xxx.lanl.gov/abs/physics/0605035
Modifying the probability of coalescence-fragmentation so that larger attack units are more rigid, gives

\[ n_s \propto N \cdot \exp \left\{ s \ln \left( \frac{(1-\nu)}{2(1-\nu)} \right) \right\} \cdot s^{-\frac{5}{2}} \]

Total attack strength = \( N \)

- \( \delta = 0 \) corresponds to a power-law with \( \alpha = 2.5 \)
- \( \delta = 0.7 \) corresponds to a power-law with \( \alpha = 1.8 \)
**Encounter Fragmentation Model**

Definition of terms and parameters:

- \( n = \) Smaller cluster size
- \( NA, NB = \) Total population size of A,B
- \( CS = \) Small cluster casualty scale
- \( CL = \) Large cluster casualty scale

Select a cluster with uniform probability

Select a cluster with probability proportional to size

Compare cluster population types

- **Same type** → Clusters coalesce

Different types

- Different sizes
  - Smaller cluster loses a random amount of agents between 0 and \( CS \times n \)
  - Larger cluster loses a random amount of agents between 0 and \( CL \times n \)

- Same size
  - Each cluster loses a random amount of agents between 0 and \( CS \times n \)
  - Both clusters fragment into randomly sized clusters

Smaller cluster fragments into randomly sized clusters

Recruitment: (for both populations)
Add a new agent to a randomly selected cluster if population is below \( NA \) (\( NB \))
0 - 6 months and similar results for the conflicts in Colombia, Afghanistan, etc.

(Poisson distribution)
Conclusion

We find extraordinary similarities in the size distribution of violent events and the timing of insurgent/guerrilla attacks in Iraq and Colombia.

Iraq and Colombia differ strongly in a number of highly visible ways.

- Colombia has “rough terrain”, i.e., extensive mountains and jungles, completely contrary to Iraqi geography.
- Iraq has strong ethnic/religious cleavages, completely unlike Colombia.
- The ideologies of Colombia’s insurgent groups, more or less Marxism, differ strongly from the ideologies of the insurgent groups in Iraq.

But a common underlying logic renders both conflicts structurally almost identical along two key dimensions.
Moreover, we get strikingly similar patterns on the size distribution of events for Afghanistan, Indonesia, Israel-Palestine, Northern Ireland, Senegal (Casamance), Sierra Leone, El Salvador, Uganda and Peru, i.e., there seems to be a very reliable pattern to modern insurgency.

These patterns are also very similar to the size distribution of casualties in terrorist events.

So “Modern War” seems to be a valid category of analysis.
Geography, ethnicity, religion and ideology are not unimportant - various wars and global terrorism do differ and good analysis must make reference to local specifics.

But there seems to be an underlying logic to insurgency and terrorism that should be central to the study of modern conflict.

There is a potentially high payoff to in-depth, micro-level studies of individual wars combined with comparative work ranging across these wars and terrorism.