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"Three Can Keep a Secret if Two Are Dead" (Lavigne, 1996): Weak Ties as Infiltration Routes ⋆

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Abstract. Among several ways of trying to suppress terrorist conspiracies, infiltration has probably received the least attention. Impressionistic evidence suggests that conspiracies that carry out violent attacks usually have a small number of participants, and that large conspiracies either fail to materialize, fail to organize actual attacks, or are substantially less difficult to uncover. Due to the prevalence of weak social ties in larger groups there may be an intermediate group size, around 7–10 members, that is highly subject to infiltration. Building on work by Freeman, Granovetter, and others, this study examines a few features of the social ecology of interaction ties. We introduce a procedure for counting, within groups of size n, all interacting pairs $\{P, Q\}$, where P and Q are disjoint or nonoverlapping subsets (Freeman, 1992: 153) of a given group; these subsets usually contain more than one person, i.e., the interacting units do not invariably consist of individuals. This procedure generates interaction configurations having unique patterns of strong, weak, and "weakest" ties – i.e., three levels of tie strength corresponding to core, primary, and secondary ties in Freeman's terminology – such that relatively weak ties predominate within larger conspiracies. We speculate about ways in which these configurations may evolve through time.

We then use a combinatorial analysis of group structure to develop a rough calculation of the probability of infiltrating conspiracies of size n, and we show that relatively large conspiracies, having 7 or more members, tend to have interaction structures that make them highly vulnerable to infiltration. Finally, Collins' (1985: 170–172) approach to interaction-chain analysis suggests that, while in real situations it would be hard to anticipate departures from our probability model, attempts to "turn around" conspirators with weak ties appear to have a fairly high prospect of success.

– But the child's sob in the silence
– Curses deeper than the strong man in his wrath.
– Elizabeth Barrett Browning, "Cry of the children"

Key words: mathematical sociology, terrorist conspiracy, infiltration, law enforcement, social networks, network analysis, group dynamics, group size, combinatorial analysis, Maple computer algebra system.

This paper argues that large conspiracies are probably more likely than small conspiracies to get caught; it speculates about structural features, related to group size, that may lead to such vulnerability. The paper also suggests that if, due to

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modern computer technologies, terrorist conspiracies of the future have global dimensions (Coates, 1996) with a preponderance of weak ties, there may be enhanced opportunities for indirect infiltration, i.e., for turning around conspirators and eliciting their cooperation, say, as informants. Among counter-terrorist strategies and tactics, infiltration probably should be emphasized more strongly than deterrence, target hardening, retaliatory or "no deal" policies, all of which assume either that an attack has already taken place or that attacks are imminent and must therefore be deterred through threats of severe punishment, by warning potential targets, by making attacks more difficult to accomplish, etc. Infiltration, on the other hand, may produce evidence of conspiracy (Lyman and Potter, 1997: 10–11, 428–229), typically the earliest phase of a collective criminal process, and it therefore provides opportunities for prosecution at a stage when conspiratorial groups themselves have not yet hardened into determined criminal organizations. Indeed, a "dissatisfaction stage" may occur early in the life cycle of such organizations (Lacoursiere, 1980: 30–41), perhaps providing an auspicious moment for infiltration.

Nonetheless deterrence, retaliation, and "no deal" policies seem to prevail in Congressional testimony (Busby, 1990) despite evidence that these policies have had mixed results at best (Brophy-Baermann and Conybeare, 1994). Deterrence appears to be the pre-eminent pre-attack strategy; from the standpoint of this paper, it should be supplemented with more effective infiltration. Efforts at target hardening, along the lines of those undertaken just prior to the recent assassination of four U.S. oil company employees in Pakistan (New York *Times*, 13 November 1997), also appear to be limited in their efficacy; such efforts may tend to produce substitution of softer targets. In the Pakistani situation, there were probably extensive opportunities for indirect infiltration.

Any infiltration effort must focus on group structure. Freeman (1992) discusses the evolution of social-science ideas about the structure of small groups, citing Tönnies on *Gemeinschaft*, Durkheim on organic solidarity, and Spencer and Cooley on primary groups. He describes a study in which the strongest social ties existed among the "core members" of groups, slightly weaker ties among "primary members", and the weakest ties among "secondary members". This characterization of group structure, Freeman says, is "common" in the literature, but he continues that "... most attempts to specify group structure represent interpersonal linkages in binary, or on/off terms". He argues that we need more detail about the internal structure of groups (Freeman, 1992: 153), with structure defined largely in terms of strength of ties. His analysis focuses primarily on testing a hypothesis drawn from structural-balance theory against an alternative hypothesis drawn from recent work emphasizing strong versus weak social ties. The structural-balance formulation implies that there should be few "intransitive triples", e.g., that if an individual is strongly tied to two others, the two others are likely to be at least weakly tied to each other. The alternative hypothesis, instigated primarily by Granovetter (1973), states that such closure often fails to materialize, and that intransitive triples occur empirically with high frequency. Freeman analyzes several datasets, concluding that intransitivities are "... present in considerable number" (1992: 159). We shall see below that, given the tendency for intransitivities to produce relative social isolation, they may facilitate infiltration.

Freeman (1992: 153) suggests that the distribution of strong and weak ties is likely to be influenced by the unique properties of specific social contexts, such as home, school, workplace, etc. Our own view is that a useful taxonomy of such contexts or social situations is provided by the POET paradigm of human ecology (Duncan, 1959; Schnore, 1961; Blau, 1977), supplemented by Ogburnian theses about innovation, diffusion thereof, and adaptations thereto (Ogburn, 1964). Coates (1996), for instance, suggests that, due to modern technologies of communication, weak ties established within terrorist conspiracies may have a unique ability to reach locations, persons, and organizations that, up until recent years, have remained generally outside the boundaries of a given social network. From the Ogburnian standpoint, one should mention also that within the framework of modern means of communication there are specific technologies for making electronic communication more secure, such as the various programs based on public-key encryption (PKE). In itself, PKE would create a need for stronger emphasis on network structures independently of communication content, and on direct or indirect infiltration as a way of obtaining information about conspiracies. Encryption keys made widely available to the public, and perhaps even to co-conspirators, are hard to change, and it is similarly difficult to change the corresponding decryption keys; buying decryption keys from defectors would be an appropriate tactic (see the discussion of decryption at <http://faculty.wm ...).

The present paper follows several of Freeman's suggestions. We examine the specific context of terrorist conspiracies; presumably, this selectivity minimizes "overlap" among groups (Freeman, 1992: 153). We develop a measure of strength of social ties that has three distinct levels of intensity, as contrasted with the typical binary scheme. We assume, with a modicum of support from Freeman's work, that a lack of closure (i.e., a lack of transitivity) would be a common feature of relatively large terrorist conspiracies, that such groups would tend to be intransitive at their peripheries where weak ties prevail, and that a plethora of weak-tie intransitivities would create special opportunities for direct or indirect infiltration by law enforcement personnel.

1. Relationships

```
> restart;
```

The above command clears computer registers for the software system (Maple) used in this article.[1]

Our major hypothesis is that as conspiracies become relatively large, perhaps taking on global dimensions, it is more likely that a given conspirator will become an informant because s/he is likely to have weak ties to the conspiracy with consequent lower rates of differential association within it – lower frequency, intensity, priority, and duration of interaction. In addition, for larger conspiracies law enforcement has more opportunities for infiltration, contacting one or two members at a time from a relatively lengthy queue which in itself takes on interesting new properties within large conspiracies. Both of these factors – weak ties and large numbers – operate jointly in such a way that large conspiracies should be substantially less difficult to infiltrate.[2]

In this study, group size should be regarded as the major independent variable, and our major hypothesis suggests that as group size increases, the density of ties within a given group tends to decrease. We do not completely share Scott's (1991: 77–78) worries about the "... fundamental problem" occasioned by the possibility that "... larger graphs [i.e., larger *n*'s] will, other things being equal, have lower densities than small graphs", a possibility that allegedly "... prevents density measures being compared across networks of different sizes" and that is "... linked, in particular, to the time constraints under which agents operate". The size/density relationship remains an empirical question, as does the question whether "time constraints" – the fact that a large number of ties for a given person require lots of time – act as a mechanism or intervening variable (Bunge, 1997). Further, this "fundamental problem" has much in common with a recurring dilemma of demography – the problem, for instance, of explaining human fertility: It is conventional to assume that a large population will necessarily produce more babies than a small population, and that therefore one should calculate a birth rate that standardizes births by population size. Perhaps, however, it would be advantageous to take population size as one of many independent variables that may have an impact on the number of babies born: Merely using population size as an unweighted, unadjusted divisor eliminates the possibility, for instance, that one may discover some sort of nonlinearity between population size and number of births, net of other factors.

With regard to terrorism we suggest, in brief, that most terrorist actions "... involve only a few terrorists who generate more noise than injury", that "... most terrorist organizations are small, short-lived operations", and that relatively large terrorist organizations "... frequently find themselves splitting" (White, 1998: 34, 40) if not disintegrating for other reasons.

We begin, then, by assuming that a plausible size for any given conspiracy is around a dozen members or fewer, down to Lavigne's (1996) minimal ideal size for a Hell's Angels conspiracy, which presumably was one – to which we should add at least one individual to allow for a sociological dimension. The appropriate assignment is

```
> maxsize := 11;
```

$$\text{maxsize} := 11$$

We apply a formula that obtains the number of relationships, R, that potentially exist within a group of size n. The function will be called $R(n)$. It increases rapidly with group size, primarily because it allows relationships to be established between and among individuals, between and among subsets of individuals, and between and among combinations of individuals and subsets. In mathematical terms, for a group of n individuals we want to count all pairs $\{P, Q\}$ where P and Q are disjoint nonempty subsets of n; then, we shall add one unit to accommodate a group structure in which all members are held together by strong (core) ties, so that one of the subsets $\{P, Q\}$ would be empty. The appropriate function is

$$R := n \to \frac{3^n - 2^{(n+1)} + 1}{2} + 1,$$

and it is subject to rearrangement.

```
> R := n -> (((3^n - 2^(n+1)) + 1) / 2) + 1;
```

$$R := n \to \frac{1}{2}3^n - \frac{1}{2}2^{(n+1)} + \frac{3}{2}.$$

In the Maple computer algebra system, the expression "`R := n ->`" should be read "R is defined as a function of n".

Let's examine a few instances by substituting values of n into the function:

```
> R(2); R(3);

> R(4); R(5);

> R(9); R(10);

> R(15); R(18);
```

2

7

26

91

9331

28502

7141687

193448102

Clearly, this function accelerates at a high rate. To understand the formula, we begin with a standard table of binomial coefficients. For a conspiracy involving 3 persons, we see that there are 3 combinations of 1 person, 3 combinations of 2 persons, and 1 combination of 3 persons. Call these persons A, B, and C, and list the combinations as follows:

A

B

C

AB

AC

BC

ABC

The $R(n)$ formula, however, tells us that a conspiracy of 3 persons has seven potential *relational structures*:

A with B

A with C

B with C

A with BC

B with AC

C with AB

ABC

Notice that in the case, say, of C with AB, the AB relationship involves a tie that is somehow different from the "with" tie. We shall assume that adjacent combinations, such as AB, represent relatively strong, core ties; the *with* connector, in contrast, implies a relatively weak (primary) tie (Granovetter, 1973) with the core. The core of a group may appear either in the P subset or the Q subset. Persons AB, then, would represent a generally more cohesive group than A *with* B; the latter is a more transitory pattern. In academe, for instance, faculty members sometimes have a transitory meeting or two with a committee that may have three or four well-entrenched members, with considerable cohesiveness among themselves. Finally, we must consider the meaning of the configuration B *with* C from the standpoint of A. In this instance the conspiracy has been attenuated to the point where B and C have a weak (primary) tie, while the relationship between each member of this dyad – or perhaps only one member – and A is weaker yet. Person A belongs neither to the P subset nor to the Q subset, but to a residual subset. In such instances, of which there are many, we propose that an additional level of tie intensity or differential association be introduced under the rubric "weakest" or secondary ties. The idea of differential association implies, as suggested above, that along with an emphasis on "duration of a relationship" and the potentially "transitory" character of it (Montgomery, 1994: 1215), we should also take into account the frequency of contacts, their intensity, and their priority. The $R(n)$ formula embodies the assumption that if, at any given moment, there is not at least one strong tie among n individuals, or at least one tie involving the *with* relationship, then there is no conspiracy at all.

In a conspiracy of 4 members, the $R(n)$ function accelerates very quickly. There are now 26 potential relational structures, counted as before. Again, the table of binomial coefficients shows that in a 4-person group there are 4 combinations of 1 person, 6 of 2 persons, 4 of 3 persons, and 1 of 4 persons:

A

B

C

D

AB

AC

AD

BC

BD

CD

ABC

ABD

ACD

BCD

ABCD

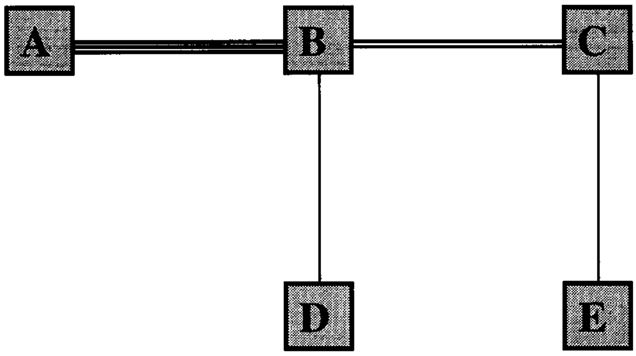

Figure 1. A five-member conspiracy of form "AB with C", illustrating strong (core), weak (primary), and weakest (secondary) ties with complete nontransitivity.

We therefore have 4 + 6 + 4 + 1 = 15 individuals or sub-groups that we need to interrelate and count in order to see that they would support 26 potential relational structures.

There are 6 structures that have the form A with B;

12 structures that have the form A with BC;

4 structures that have the form A with BCD;

3 structures that have the form AB with CD;

and 1 structure that has the form ABCD.

For all triads or larger groups with strong ties, we assume a high degree of transitivity (Granovetter, 1973: 1376); for instance, in the form A with BCD, we assume that the strong tie from B to C and from C to D implies a strong tie from B to D. However, in a configuration such as AB with C for a group where $n = 5$ (see Figure 1), the weakest (secondary) ties of D and E with the more cohesive members would probably not imply anything about the relationship between D and E themselves; therefore, transitivity is entirely lacking. Given the marginality of D and E (Weimann, 1982), it would be possible for a law-enforcement agent to communicate with one of them with the assurance that the other might never learn anything about such contact. Thus, a lack of transitivity would imply that marginal individuals "... are not highly integrated within their own groups ... thus maintaining 'external ties' with individuals from other groups" (Weimann, 1982: 766) – individuals who may be, or may be seeking, indirect infiltrators.

2. Relational structures of larger groups

Consider the more complicated case involving a group with 5 members. Here it is helpful to invoke the Maple program library for combinatorial analysis.

```
> with (combinat):

Warning, new definition for Chi
```

List combinations ranging in size from 1 through 5, and corresponding to the binomial coefficients for $n = 5$

```
list1 := choose([A, B, C, D, E], 1);
```

$$\text{list1} := [[A], [B], [C], [\text{D}], [E]]$$

```
> list2 := choose([A, B, C, D, E], 2);
```

$$\text{list2} := [[A, B], [A, C], [A, \text{D}], [A, E], [B, C], [B, \text{D}], [B, E], [C, \text{D}], [C, E], [\text{D}, E]]$$

To save space, we suppress output by using the : (colon) symbol to end several input lines. The additional lists will appear in the discussion following.

```
> list3 := choose([A,B,C,D,E], 3):

> list4 := choose([A,B,C,D,E], 4):

> list5 := choose([A,B,C,D,E], 5):
```

In this case, there are several interaction forms:

Form 1: A with B

Form 2: A with BC

Form 3: A with BCD

Form 4: A with BCDE

Form 5: AB with CD

Form 6: AB with CDE

Form 7: ABCDE

There are, as we see above, 10 dyadic relationships having the form A with B (Form 1):

```
> list2;
```

[[*A*, *B*], [*A*, *C*], [*A*, D], [*A*, *E*], [*B*, *C*], [*B*, D], [*B*, *E*], [*C*, D], [*C*, *E*],

[D, *E*]]

Thirty relationships have the form A with BC. In this case, BC have a strong tie, and A has a weak tie with BC. The same holds for other structures of Form 2. The value 30 occurs because each entry in *list1* can be combined with 6 entries in *list2*. Person A, for instance, may have a tie with any core group from *list 2* that does not include A.

```
> list1; list2;
```

[[*A*], [*B*], [*C*], [D], [*E*]]

[[*A*, *B*], [*A*, *C*], [*A*, D], [*A*, *E*], [*B*, *C*], [*B*, D], [*B*, *E*], [*C*, D], [*C*, *E*],

[D, *E*]].

Another 20 relationships have Form 3, A with BCD. Each member has a potential relationship with 4 combinations of 3.

```
> list1; list3;
```

[[*A*], [*B*], [*C*], [D], [*E*]]

[[*A*, *B*, *C*], [*A*, *B*, D], [*A*, *B*, *E*], [*A*, *C*, D], [*A*, *C*, *E*], [*A*, D, *E*], [*B*, *C*, D],

[*B*, *C*, *E*], [*B*, D, *E*], [*C*, D, *E*]].

Now Form 4, A with BCDE. Five logical possibilities.

```
> list1; list4;
```

[[*A*], [*B*], [*C*], [D], [*E*]]

[[*A*, *B*, *C*, D], [*A*, *B*, *C*, *E*], [*A*, *B*, D, *E*], [*A*, *C*, D, *E*], [*B*, *C*, D, *E*]].

Next, AB with CD (Form 5). Here, using a single list, we have to be careful not to count both AB with CD and CD with AB. (For relationships of form A with B, Maple took care of this problem for us.) Fifteen logical possibilities.

```
> list2; list2;
```

$[[A, B], [A, C], [A, \mathrm{D}], [A, E], [B, C], [B, \mathrm{D}], [B, E], [C, \mathrm{D}], [C, E], [\mathrm{D}, E]],$

$[[A, B], [A, C], [A, \mathrm{D}], [A, E], [B, C], [B, \mathrm{D}], [B, E], [C, \mathrm{D}], [C, E], [\mathrm{D}, E]].$

Then, AB with CDE (Form 6). Ten possibilities.

```
> list2; list3;
```

$[[A, B], [A, C], [A, \mathrm{D}], [A, E], [B, C], [B, \mathrm{D}], [B, E], [C, \mathrm{D}], [C, E], [\mathrm{D}, E]]$

$[[A, B, C], [A, B, \mathrm{D}], [A, B, E], [A, C, \mathrm{D}], [A, C, E],$

$[A, \mathrm{D}, E], [B, C, \mathrm{D}], [B, C, E], [B, \mathrm{D}, E], [C, \mathrm{D}, E]].$

Finally, Form 7:

```
> list5;
```

$[[A, B, C, \mathrm{D}, E]].$

The total number of potential relationships, 91 for groups of 5 members, may be obtained far more easily by the $R(n)$ formula, where n is the size of the group:

```
> R(5);
```

91,

Checking. If necessary, make a boolean test using the "evalb" command.

```
> t := 10+30+20+5+15+10+1:

> evalb(R(5) = t);
```

true.

In a discussion of the theory and methods of network analysis, Scott (1991: 73–74) points out that, as conventionally defined, an undirected graph[3] with n points can contain a maximum of $\frac{n(n-1)}{2}$ distinct lines connecting points within the graph. For $n = 5$, then, a graph of maximum density would have a total of ten lines. Density is calculated by dividing the observed number of lines by this maximum, and it therefore varies from 0 to 1 (Scott, 1991: 74). Thus, the density concept implies that a graph may well apply to a number of individuals who have few if any network relationships among themselves; the majority of points may be social isolates. The number of different density configurations possible for $n = 5$, again, may be found by examining a table of binomial coefficients. It is the sum of all combinations of zero lines, one line, two lines, etc., through ten lines, and it is calculated as follows:

First, obtain the maximum density for an undirected graph with n points:

```
> maxdensity := n -> (n*(n-1))/2;
```

$$\text{maxdensity} := n \rightarrow \frac{1}{2}n(n-1).$$

Then, express this function for $n = 5$:

```
> maxdensity(5);
```

$$10.$$

Next, obtain the appropriate set of combinatorial values from a table of binomial coefficients, and check the sum of these against the corresponding binomial expansion, i.e., 2 raised to the maximum density for a given n:

```
> 2*(1+10+45+120+210) + 252 = 2^maxdensity(5);
```

$$1024 = 1024.$$

There are, then, over a thousand ways in which a set of five points may be connected so as to generate any one of the eleven scoring possibilities (within the range 0 to 1) for density. Notice that this set of logical possibilities is substantially greater than that defined by the $R(n)$ formula for groups in which $n = 5$. In this sense, the $R(n)$ formula is parsimonious.

When $n = 6$, the maximum number of lines for an undirected graph escalates rapidly to 15, and we see again from a binomial expansion that the number of possible density configurations for such a graph may increase rapidly:

```
> maxdensity(6);
```

$$15.$$

```
> 2^maxdensity(6);
```

$$32768.$$

$R(n)$ is relatively subdued:

```
> R(6);
```

$$302.$$

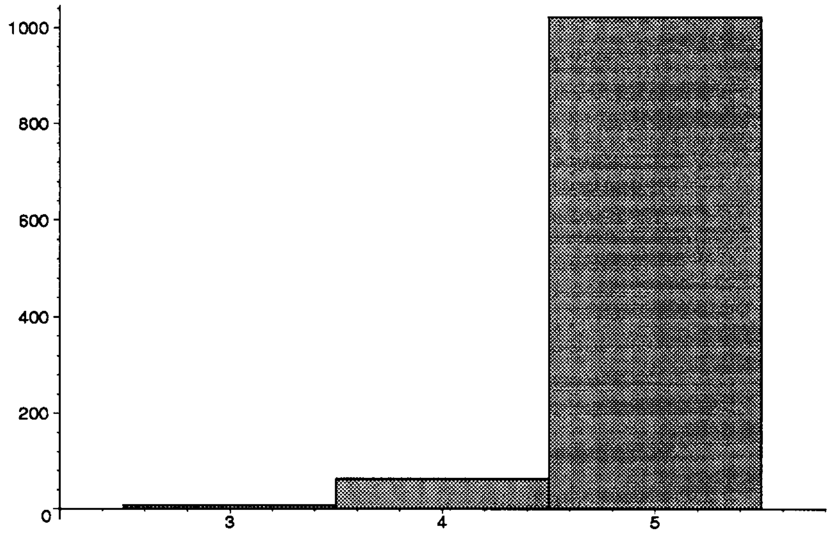

Figure 2. Impact of group size on maximum density.

A pair of simple histograms (Figures 2 and 3) will show how these two processes behave for very small groups ranging in size from $n = 3$ to $n = 5$:

```
> with(stats [statplots]):

> data1 := [Weight (2.5. .3.5, 2^maxdensity(3)), Weight(3.5. .4.5,
2^maxdensity(4)), Weight(4.5. .5.5, 2^maxdensity(5))] :

> histogram(title = 'Figure 2', data1, xtickmarks=3);
```

The same procedure for $R(n)$ tells a different story:

```
> data2 := [Weight(2.5. .3.5, R(3)), Weight(3.5. .4.5, R(4)),
Weight(4.5. .5.5, R(5))]:

> histogram(title = 'Figure 3', data2, xtickmarks=3);
```

Plots make the point convincingly, but comparing a series of integer values for group size is also appropriate:

```
> R(3); 2^maxdensity(3);
```

7

8

```
> R(4); 2^maxdensity(4);
```

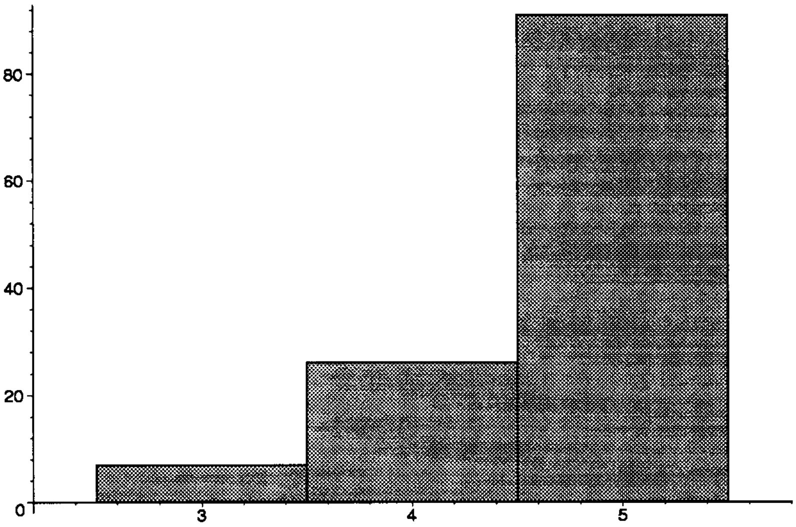

Figure 3. Impact of group size on $R(n)$.

26

64

```
> R(6); 2^maxdensity(6);
```

302

32768

```
> R(9); 2^maxdensity(9);
```

9331

68719476736

```
> R(11); 2^maxdensity(11);
```

86527

36028797018963968.

This parsimonious state of affairs arises because, in the language of network theory, a conspiratorial *group* does not have social isolates – if one is a member of the group, one is not isolated by definition – and it does not allow disconnected sub-group components (Scott, 1991: 104–117).

3. Dynamics

Each of the forms identified by the $R(n)$ formula may be highly changeable, highly evanescent, implying that we might try to predict transformations from one form to another (Lacoursiere, 1980). If, for instance, a group having five members arrives at a point where only two of them interact weakly, as in Form 1, we might predict that the conspiracy is in the process of dissipating, or dropping to a smaller value for n. If Form 3 prevailed at some point, however, it is reasonable to expect that it might evolve into Form 5 rather than, say, Form 4: In Form 5, A, B, C, and D have made a small adjustment of their own patterns of differential association, while E continues to have weakest ties. Form 4 would only emerge if E's role in the group were completely transformed. Remember, however, that Form 5 can occur in 15 different ways compared to only 5 ways for Form 4, and one would have to take this into account in trying to ascertain whether, in the present example, E's role could be thusly transformed.

The human ecological perspective emphasizes temporal and spatial dimensions of social phenomena (Hawley, 1950: Chapters 13–15; Sanders, 1958: Chapter 11). Regarding the time dimension it is plausible, for instance, that if there were a change in the size of a seriously criminal conspiracy – say, a conspiracy involved in planning a large-scale bombing – the change would tend to be downward, as early participants with weak or weakest ties, perhaps experiencing dissatisfaction (Lacoursiere, 1980), sever connections; such former members, however, have immense potential value as informants and they should be sought out aggressively even in situations where they no longer seem to be strongly in evidence. Weak ties sometimes reach far backwards through time, perhaps spanning several years or even decades; this is another paradoxical dimension of their strength. Recently, one has the impression that the most extreme acts of terrorism, at least in the United States, have involved only two or three perpetrators in the final stages, but several additional co-conspirators in earlier stages. We would also anticipate that, as we learn more about those planning the recent assassination (12 November 1997) of four U.S. citizens in Pakistan, it will probably turn out that the actual perpetrators were few in number and that several marginal individuals with weak ties were spun off early from the central core of this conspiracy. These marginal members should perhaps have been exploited more effectively, especially since it was known well before the occurrence of the assassination that some sort of attack was probably imminent.

Another reason for group evolution is the constant need to find specific kinds of criminal skill. This factor can be illustrated with reference to our observations while attending the 1993 Paris Air Show. The occasion was auspicious because 1993 was the first occurrence of the Paris Air Show in which Russia, subsequent to the collapse of the U.S.S.R., had a large, expansive, and impressive role; relations between the French and the U.S., by contrast, were generally hostile and suspicious. In brief, what we observed was a process involving the establishment of social ties within a wide range of prestigious social settings: The quintessential interaction arena (of which there were many) might consist, say, of an expensive, ostentatious luncheon in the grandest Parisian traditions, held within the charming patio of a semi-permanent pavilion set up on the aviation ramps of Le Bourget airport and operated by a major global corporation, permitting guests to conduct multi-billion dollar negotiations while enjoying splendid company and a splendid meal and watching low-altitude, low airspeed fly-bys involving fantastically advanced aircraft. One wonders what the factors are that keep such activities from generating the most dangerous varieties of terrorist attack by highly dispersed organizations – i.e., attacks in which high-technology military ordnance would be deployed, – as contrasted to the more typical situation in which the terrorist ignites what is essentially a truckload of fertilizer. In the high-tech scenario, the problem for the potential terrorist has to do with weak ties: In order to bring together the necessary resources, a conspirator would have to gain access to extraordinarily large sums of money; she would have to translate these funds into the essential military hardware and software, with the proviso that these steps would imply personnel with the skills necessary for handling and operating advanced weaponry; she would have to gain access to appropriate means of transportation and effective means of communication, command, and control. These necessities are probably a minimal list, and many additional resources would prove to be essential. Yet, they would create inexorably a network of weak ties that would constitute the soft underbelly of the conspiracy. We suggest that in instances where such an attempt is undertaken, it almost invariably fails. For anti-terrorist organizations, this is perhaps another instance of the strength of weak ties.

4. Conspiratorial Ties and the Prospects of Defection

When $n = 3$, person A is involved in 6 of the 7 possible group structures; when $n = 4$, person A's prospects of strong-tie participation decline rapidly, and they continue doing so for larger conspiratorial groups that have many possible configurations in which, at least temporarily, a given individual has neither strong nor weak ("with") ties; such participants, as we already have established, may be said to have weakest ties. This pattern, again, implies that in a relatively large group, differential association for any given participant has a prospect of dropping sharply, and that any given participant, likely to have minimal ties to the conspiracy, would therefore be relatively likely to defect.

We begin with the probability of turning around at least one member of a given conspiracy, and we call this probability p. The constant *k1* provides a way of initializing the value of this expression; the probability will decrease sharply for smaller conspiracies. The value *k1* is an initialization subject to modification through feedback. Recall that the central objective of this study is to enhance prospects of a "successful" outcome whenever infiltration efforts occur, and it is conceivable that law-enforcement agents, if they learned to appreciate the subtleties of group dynamics, would increase the proportion of contacts that bring about some sort of successful outcome; in this case, feedback would raise *k1* appropriately thereby creating greater optimism regarding the prospects of success for future contacts involving groups of any given form. On the other hand it is entirely possible that things would go wrong, and the initial value for *k1* would turn out to have been unduly optimistic. In either case, we presumably have self-correction through feedback (Faia, 1986).

Notice that n, the size of a given conspiracy, will not be larger than *maxsize*. For a conspiracy involving n individuals, then, the probability of converting one of them into an informant will be indexed by the following rough calculation for p, in which *maxsize* and *k1* are set to reasonable values for which, as stated, there may be a degree of empirical support. For experiments, either of these values may be changed.

```
> k1 := 4/13;
```

$$k1 := \frac{4}{13}.$$

A reminder:

```
> R(n); R(maxsize);
```

$$\frac{1}{2}3^n - \frac{1}{2}2^{(n+1)} + \frac{3}{2}$$

$$86527.$$

And now the equation for p: Multiply *k1* by the fraction $\frac{R(n)}{R(\text{maxsize})}$, which will reduce the size of *k1* for relatively small groups. We show these two expressions separately, in order to clarify the algebra. Notice that Maple reorganizes p into three terms.

```
> k1; (R(n)/R(maxsize));
```

$$\frac{4}{13}$$

$$\frac{1}{173054}3^n - \frac{1}{173054}2^{(n+1)} + \frac{3}{173054}.$$

We then calculate $p := k1\ \frac{R(n)}{R(maxsize)}$, as follows:

```
> p := k1*(R(n)/R(maxsize));
```

$$p := \frac{2}{1124851}3^n - \frac{2}{1124851}2^{(n+1)} + \frac{6}{1124851}.$$

Again, some substitutions. Try $n = 5$ and $n = 8$, and translate them into floating-point values.

```
> subs(n=5, p); evalf(%, 3);
```

$$\frac{4}{12361}$$

0.000324

```
> subs(n=8, p) ; evalf(\%, 3);
```

$$\frac{12104}{1124851}$$

0.0108.

A small probability, not encouraging. Next, we obtain the probability q of failing to turn around a given conspirator whom we have contacted. We repeat p, and then subtract it from 1:

```
> p;
```

$$\frac{2}{1124851}3^n - \frac{2}{1124851}2^{(n+1)} + \frac{6}{1124851}$$

```
> q := 1 - p;
```

$$q := \frac{1124845}{1124851} - \frac{2}{1124851}3^n + \frac{2}{1124851}2^{(n+1)}.$$

Notice that, algebraically, the first term of q is taken initially to be one, and then it is modified by having the last term of p subtracted from it while the remaining terms change sign.

Even for a fairly large conspiracy, then, our chance of success with a given contact are small, i.e., q remains high.

```
> subs (n=10, q); evalf (%, 3);
```

$$\frac{1010843}{1124851}$$

0.899.

Now we need the probability of failing to cause a defection among any of n conspirators, i.e., the probability of failing to infiltrate a given conspiracy. We raise q to the nth power:

```
> fail := q^n;
```

$$\text{fail} := \left(\frac{1124845}{1124851} - \frac{2}{1124851}3^n + \frac{2}{1124851}2^{(n+1)}\right)^n.$$

The following, then, is the probability of successful infiltration:

```
> succ := 1 - fail;
```

$$\text{success} := 1 - \left(\frac{1124845}{1124851} - \frac{2}{1124851}3^n + \frac{2}{1124851}2^{(n+1)}\right)^n.$$

This gives us a basic model. A few substitutions should persuade us that prospects of successful infiltration increase rapidly as conspiratorial groups become larger:

```
> subs(n=3, success); evalf(%, 3);
```

$$\frac{309859169788}{4149453252332557}$$

0.0000747

```
> subs(n=6, success); evalf(%, 3);
```

0.00643

```
> subs(n=7, success); evalf(%, 3);
```

0.0238

```
> subs(n=8, success); evalf(%, 3);
```

0.0829

```
> subs(n=9, success); evalf(%, 3);
```

0.262.

Whenever a new member is added to a conspiracy, then, the probability of infiltration appears to increase by an accelerated amount. But the function $R(n)$ also tells us that, when a conspiracy has fewer than approximately seven members, attempts at indirect infiltration are not likely to succeed, and law-enforcement agencies should probably seek other means such as using their own personnel as direct infiltrators, traditional communication taps – tantamount, sociologically, to introducing new members who remain anonymous – a greater emphasis on deterrence and retaliation (Brophy-Baermann and Conybeare, 1994), and so forth. Although use of law-enforcement agents to penetrate small conspiracies is dangerous and also entails a serious prospect of entrapment as a legal defense whether real or contrived, the addition of a single new group member, according to $R(n)$, may have a considerable impact on the prospects of eliciting cooperation from other members. Even if the new member were herself an undercover law-enforcement agent, her active presence as a group member could have the impact of a break shot in a pool game (cf. Wasserman and Faust, 1994: 568), scattering the real members sociologically and making them considerably more vulnerable to a turn-around process.

5. Interaction Chains, Indirect Infiltration, and the Concurrent Feedback of Information and Disinformation

Collins (1985: 170–172) argues that the needs of social theory would be well served by intensive analysis of interaction processes involving the behavior of larger, macrosocial entities. "The potential is now present ...", he says, "to build together the microanalysis of face-to-face interaction in all sorts of situations, into a theory of the macrostructure of the state, of organizations, and of classes .... The networks made out of such *repeated*[4] ritual encounters make up the reality of the larger structures". I should like to provide three brief illustrations of this process, followed by an elaboration of the feedback dynamics of the sort of infiltration process discussed herein.

An excellent opportunity for the application of Collins' philosophy is found in a standard statistics textbook (Runyon and Haber, 1988: 418) where it is pointed out, in essence, that from 1922 until 1979 the teams that played in the world series were *more than evenly matched*. This paradoxical claim is based on the following consideration, assumption, and observation: (1) the series must end with the completion of four, five, six, or seven games; (2) given that "evenly matched" implies that each game is tantamount to a coin flip, there is a readily ascertained probability distribution[5] for the four possible outcomes; (3) the world series has continued for six or seven games significantly more often than what is expected under the assumption, as defined in (2), that teams are evenly matched. There must, then, be some sort of counter-momentum brought about by concurrent, on-the-fly feedback that causes a team that has lost several early games to make an unusually strong comeback, and it is this game-to-game (or encounter-to-encounter) feedback that is the meat and potatoes of the Collins proposal. The counter-momentum may be largely psychological, it may have something to do with shifts in home-field advantage, it may have something to do with the squandering of resources (e.g., pitchers) in early games by teams that achieve an early advantage, and so forth; there are many hypotheses. In any case, what is important is that in order to model the world series as a macrosocial phenomenon occupying long time periods, we must take a careful look at high-frequency feedback between and among myriad subsets of the hundreds of games that comprise this lengthy interaction process.

For another instance we turn to Whicker and Sigelman (1991: 105), who made simulations of the AIDS epidemic that assume a probability of 0.005 for the transmission of the HIV, in a single instance of intercourse, from an infected (but presumably unaware) man to an uninfected woman; the couple are not practicing "safe sex". Over an interval, say, of twenty instances of unprotected intercourse, one finds that the transmission probability, $1 - \left(\frac{995}{1000}\right)^{20}$, is frighteningly high, as follows:

```
> 1 - (995/1000)^20: evalf(%, 5);
```

0.095390.

However, it is a virtual certainty that during this series of twenty or so sexual encounters concurrent feedback would modify, from one instance to the next, the initial probability of HIV transmission. Again, as in the case of the world series, there are many hypotheses as to how each sexual encounter might feed back and influence the next encounter in such as a way as to raise or lower the probability of HIV transmission. Under the assumption that the process begins with the couple practicing unprotected intercourse, there are clear prospects of lowering the HIV transmission probability. And there are indeed ways in which it could be raised, e.g., sexual practices having a higher transmission risk than genital intercourse. In any case, an epidemiological macro-process is substantially modified for better or worse when one allows for the high-frequency feedback that Collins urges upon us.

A third instance exemplifying the Collins philosophy has to do with the prisoner's dilemma, famous among game theorists. In a single instance of this game (played typically as a laboratory experiment), rationality dictates a minimax strategy founded on distrust between the prisoners – apparently the opposite of the behavior of the above lovers, and an indication that these sorts of games have very different sociological properties. Therefore a Nash-type equilibrium solution (Kreps, 1990) – both prisoners confess – is highly probable, although it does not maximize benefits. A Pareto-type solution, one in which both prisoners remain silent and thereby do maximize benefits, is much more likely to occur if the game is played repeatedly, because concurrent feedback based on past games, along with other forms of communication if they are allowed, create the possibility of building up trust and vulnerability at the same time (Kreps, 1990: 29; Fine and Holyfield, 1996). In a Pareto optimum, trust creates cooperation and high benefits despite high mutual vulnerability.

The same sort of dynamic applies in any instance where law-enforcement agents attempt indirect infiltration of conspiracies. Each attempt, successful or not, is a discrete event that is likely to have repercussions upon subsequent attempts. As in the preceding illustrations, initial probabilities are not likely to remain unchanged:[6] A Collins-style interaction chain rules out a Markov chain with its inexorable evolution toward deterministic fixed points. The steady-state equilibria or fixed points demonstrated by Montgomery (1994: 1219–1223), in a model designed to predict equitability of employment distributions, are not attainable in the present instance.

Montgomery (1994: 1215), for instance, permits strong ties only within dyads, and he assumes fixed transition probabilities among various employment categories. Neither of these features exists within the present study.

For larger conspiracies, then, law-enforcement agents must find ways of gaining maximum benefits from contacts with conspirators whose ties with their co-conspirators, ranging from strong to extremely marginal, may be highly variable due to the impact of law-enforcement contacts. The general strategy should be to make sure that a given contact does not reduce – and may even serve to enhance – the prospects of success for subsequent contacts. We have several specific suggestions:

First, social scientists should spend considerable effort in debriefing law-enforcement agents who have had substantial success in identifying and dealing with marginal members of conspiracies, i.e., in exploiting relatively weak ties. Among other objectives, these debriefings should try to arrive at reasonable estimates of $k1$.

Second, efforts such as those of Turnbull (1962: Chapter 2) to understand marginality suggest that relatively weak ties often create high anxieties among those relegated to marginal statuses, and these anxieties should be exploited. Turnbull provides an excellent illustration of ways in which marginality arising from "betweenness" – a standard concept of graph theory (Scott, 1991: 89–90) – may make one vulnerable to a turn-around process.

Third, in instances where one fails to elicit cooperation from a given conspirator, it is likely that he or she will communicate, perhaps along weak-tie channels, with other potential contacts closer to the core of a given group, and in talking to any such potential informant it would be wise to apply the "Gabby Hayes principle" in reverse. The Gabby Hayes principle, enunciated by Fred Rogers of the PBS "Mr. Rogers" program, is the carefully cultivated practice of talking to television mass audiences as if one were talking to "one lone little buckaroo". In talking to a conspirator with minimal ties who proves to be resistant to defection, a law-enforcement agent should assume that she is addressing the entire conspiracy, including especially the various core members with whom a given marginal member may occasionally interact. Core members, with their relatively strong ties, may facilitate the diffusion of either information or disinformation within the central configuration of a conspiracy. Any enticement for cooperation – say, a monetary payoff – should be framed in such a way that it would have broad appeal if it were somehow communicated, perhaps inadvertently, to co-conspirators either centrally located or more marginally located. If, at the same time, marginal members have little transitivity, rarely interacting with each other, they should remain amenable to a turn-around process even when several attempts already have been made among their relatively distant associates (Collins and McGovern, 1997). There is a metaphor for such intransitivity: If we think of the core of a (potentially successful) conspiracy as a (typically) small lake, the weak and weakest ties are tributaries that maintain a continuous flow into the center while nevertheless functioning independently of one another. Perhaps the most useful tactical lie to be fed into the core of a conspiracy would be the suggestion that a vast assortment of deterrence, target-hardening, retaliatory, and no-deal programs had already been deployed. Another tactical lie would suggest that Pareto optima had been established, when in fact one is preparing for a rapid descent into Nashville.

Notes

1. This paper uses Maple V Release 5, a computer algebra system. See Nicolaides and Walkington (1996). Maple input statements (preceded by the > symbol) have been retained in the text, for readers who may wish to experiment with the program described by this paper.
2. This thesis implies that small, highly cohesive organizations such as “fifth era” Ku Klux Klan groups (Lyman and Potter, 1997: 344) may be highly resistant to infiltration.
3. In an undirected graph, relationships are symmetrical: Point A relates to point B in the same way that B relates to A. Thus if the relationship involves, say, friendship choices then selections must be mutual. If a graph has relationships in which, say, A *owns* B, then it is directed.
4. Italics added. The Collins strategy works best when each link of an interaction chain is indeed a discrete event, causally implicated with events preceding and following. This condition exists in the illustrations provided herein.
5. Runyon and Haber (1988: 418) misstate this probability. Incidentally, the findings persist when recent world series are added to the dataset.
6. We showed earlier that strategies developed by this paper are designed precisely to change initial probabilities.

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