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ON SCALE AND COMPLEXITY IN CONFLICT ANALYSIS

Conflict relates two or more agents situated in space and time. These two dimensions of conflict—space and time—vary in complexity depending on the scales selected to study the unit of analysis. This paper seeks to answer the following question: what are the ‘correct’ scales for analyzing internal conflict? We consider the theoretical implications and empirical consequences of scale and complexity in conflict analysis.

INTRODUCTION

What are the ‘correct’ scales for analyzing internal conflict? International relations theory identifies three units of analysis to study the sources of international conflict: the individual, the state and the system (Waltz 1954). These units of analysis are situated in space and time both of which is arbitrary in scale. Space, for example, can be defined as a constituting a county or country while time can be represented in hours or years. At what scale—spatial and temporal—should internal conflict be analyzed? Does the answer always depend on the research question? Do different scales imply different levels of complexity?

Conflict studies have traditionally drawn on the country-year space-time scale to identify trends in conflict over time (Mack 2005, 148). Is this an appropriate scale for analyzing internal conflict? The question is relatively novel given that global conflict data at a small scale or lower level of aggregation was until recently unavailable (Buhaug and Lujala 2005, Gleditsch et al. 2002). The recent shift in the academic interest from international wars to internal wars since the thawing of the Cold War presently places greater emphasis on coding sub-national data to improve our understanding of internal conflict (Buhaug and Lujala 2005, 401). This is matched by a parallel interest in coding higher temporal resolution data. As a result these developments have begun to untie the country-year “straitjacket” that previously limited the study of internal conflict.

Several research and policy questions arise as time series data at various scales become more widely available: what are the appropriate scales for conflict analysis? How interdependent are these scales? Can we for instance delineate a causal pathway from micro-change to macro-change and vice versa?

Linking macro-level theories of conflict to a theoretical treatment of individuals' motives and actions remains problematic (Sambanis 2002, 224).¹ The purpose of this paper is to explore plausible answers to these questions and consider the implications for policy.

The paper is structured as follows. We first define our terms. Next we draw on recent empirical studies to demonstrate that conflict is not scale invariant—that is, scale matters in conflict analysis. We then consider the range of possible spatial and temporal scales for conflict analysis and assess which, in theory, might be more appropriate for analyzing internal conflict. Conceptual limitations of single-scale analysis lead us to consider alternative research methods for multi-scale conflict analysis. A natural extension is the study of conflict at cross-scales. We consider the relationship between scale and complexity throughout and conclude by highlighting the policy implications for conflict prevention.

TERMS AND DEFINITIONS

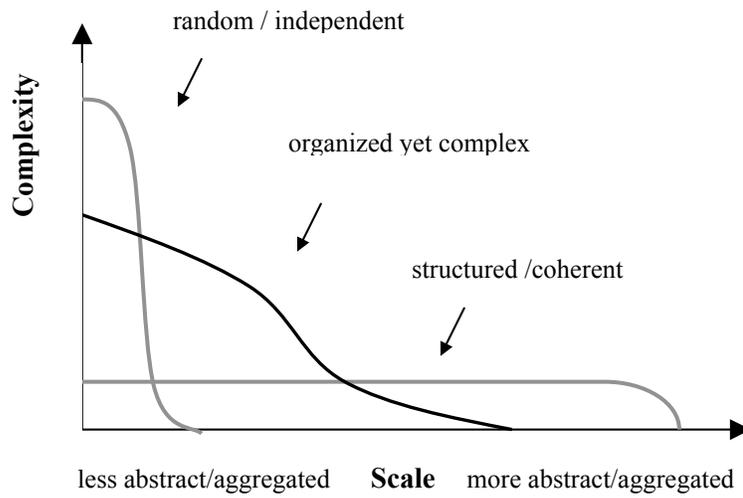
The term “complexity” denotes the degree to which a system is difficult to analyze, understand or solve. A more complex system requires more detailed analysis. Complexity arises when systems contain a large number of mutually interacting parts at many different scales. The term scale describes the magnitude or level of aggregation and abstraction employed to describe the interacting parts of a system.

Social systems arise out of relationships that reflect cooperation and conflict at different scales. At a high level of aggregation the interacting parts of a social system are represented as states or nation-states. Individuals represent a lower level of abstraction. Scale determines the occurrence or absence of a certain object class such as the state or the individual.

Complexity and scale form an interdependent relationship shown by the three curves below.

¹ The quest for an integrated understanding of the micro-macro relationship is not unique to political science. Physicists have long sought to reconcile the study of quantum mechanics with the theory of special relativity in the hopes of developing a unified field theory.

Figure 1



Complexity as a function of scale for three kinds of systems: random, structured and complex. The way a system is organized affects how it is seen at different scales. In social systems, people in crowd move aimlessly and an army moves coherently while modern international companies reflect organization yet less hierarchy (adapted from Bar-Yam (2004, 55)).

Describing systems in the world involves a decision about the level of detail we provide. The length of a description depends on how much detail we can see (Bar-Yam 2004, 54). In the figure above, the horizontal axis indicates “how far away” the observer is from the object being described. In other words, it indicates the level of precision or scale of the description. The closer the object is, the greater the detail and the more precise the description.

The vertical axis indicates the complexity of the object described by an observer. This represents the amount of information an observer needs to describe an object moving in time and space at different scales. We will devote more attention to the subject of social systems in the next sections and how these can be analyzed using the properties of complexity and scale.

The remaining term in our title, conflict, also warrants a clear definition. We define conflict as a disagreement through which the parties involved perceive a threat to their needs, interests or concerns resulting in the use of physical force. The definition of conflict can be extended from individuals to groups—such as states or nations—and many parties are generally involved which accounts for complexity in conflict.

SCALE MATTERS

Conflict analysis has long been biased toward analyzing trends over time rather than space given the lack of reliable data to inform us of the spatial elements of civil war over time” (Sambanis 2002, 239).² As a result, conflict studies define geography in a very narrow sense, “merely permitting the concept to include measures of contiguity and distance” (Buhaug and Lujala 2005, 401). However, the importance of location as a factor in political developments continues to grow (O’Loughlin 2004, 4; Turner et al. 2003, 8076).

In this section we draw on empirical studies to explain why conflict analysis is not scale invariant or scale-free. The very notion that conflict is not scale invariant suggest that a particular scale may be more ‘correct’ than another when analyzing internal conflict. We first address the role of time and follow this with a discussion of place in conflict analysis.

Time. The quantitative study of conflict has traditionally used the “year” as the temporal scale for conflict analysis. While this may not be the ideal unit of choice for quantitative analysis the available data was for the most part limited to this one temporal scale. Using the year to analyze trends over time presents some constraints. While the level of complexity or amount of analysis required to study conflict trends over years is relatively low, as Figure 1 suggests, the tradeoff is precision. The year is an aggregate figure describing several hundred days that in turn describe numerous events.

Barring some intractable conflicts, most internal conflicts tend to be in flux and have the ability to change in a relatively short period of time depending on their volatility. While conflict trends over spanning several years provide important insights into the long-term dynamics of the international system, they are blind to the short-term events that may escalate conflicts within a few months. If conflict analysis is to inform policy for conflict prevention, waiting three hundred and sixty-five days may be too long.

Take gross domestic product (GDP) or yearly casualty figures for example. Numerous conflict models draw on these figures as proxies for various indicators such as resource dependence or state failure (Buhaug and Lujala 2005, 404). While these aggregate figures may simplify the equations, any

² While the field of quantum mechanics is constrained by Heisenberg’s straitjacket, or uncertainty principle, the same may be true for conflict analysis. It may be easier to describe when a conflict event takes place than identifying the precise spatial coordinates at which this conflict event took place.

underlying changes or variations that take place within a year are averaged to this one aggregate yearly figure.

“To analyze in detail the variation of homicides over time, we cannot simply use the yearly number of deaths, as the actual observations showed considerable variation within each given year. At the same time, daily or even weekly numbers would be too detailed and variation patterns confusing. [...] Any interpretation is almost impossible” (Bockquier and Maupeu 2004, 337). However, with no underlying time series to draw on, placing great confidence in aggregate numbers is more difficult (Spagat 2005, 105).

On the other hand, “as multivariate models of conflict become more fully specified, there are simply ‘not enough wars’ for statistical analyses over shorter periods of time” (Gleditsch et al. 2002, 617). While extending the analysis to longer time periods provides more data for analysis this also raises several problems: “are the theoretical explanations equally reasonable for the whole period? Do variables like ‘degree of democracy’ and ‘economic development’ mean the same thing in 1825 as in 1985? (Gleditsch et al. 2002, 617).

A low scale (aggregate) approach thus ignores internal variations that may become important determinants of the magnitude or future trend in aggregate figures. On the other hand a high scale approach may prove “too detailed and variation patterns confusing.” That being said, identifying and monitoring more frequent variations may be more appropriate for preventive diplomacy. A lower level of abstraction in conflict analysis may lend itself better to less abstract or vague policy recommendations. Significant further progress in the research of internal conflicts will “require improved or new datasets, so that investigators can open up the black box of conflict intensity and its dynamics” (Spagat et al. 2005, 113).

Space. Conflict analysis commonly classifies conflicts by location often using world maps with distinctive coloring for countries in conflict. While this may be useful for understanding regional concerns and policies, this high scale spatial approach may “give a misleading impression of the size and location of the zones of peace and zones of turmoil. For instance, the entire landmass of Russia can be depicted as being in conflict because of the Chechnya war. A more realistic picture of the zones of conflict emerges when we plot the conflicts by their actual geographical location” (Gleditsch et al. 2002, 623-624).

A review of the empirical literature on geography and conflict shows that most conflict research “ignore local conditions and instead use aggregates in analysis. We argue that while it may be appropriate to focus on the national scale and use state-level geographical variables when exploring the risk of conflict, this research strategy is not suitable when the conflict is the unit of observation” (Buhaug and Lujala 2005, 400).

The recent study by Buhaug and Lujala (2005) empirically demonstrates that country statistics are poor approximations of the conflict zones: “The essence of the problem is that proxies for geography are generated at the wrong level of measurement: the nation state” (404). Scale matters and statistical analyses show that “certain findings are indeed dependent upon the scale of measurement” (Buhaug and Lujala 2005, 399). In fact, Buhaug and Lujala (2005) demonstrate that the scale of measurement not only influences standard errors and confidence intervals, “but even the substantive impact of some regressors” in multiple regression equations” (413).

These results confirm our conceptual intuition. Internal conflicts are by definition sub-national events, and the fighting rarely engulfs an entire country. Aggregate figures such as GDP and casualty counts only “make sense if we can assume that the conflict area constitutes a representative sample of the conflict-ridden country on all explanatory factors, and in cases in which the conflict spans the entire country. However, such an assumption is rarely valid” (Buhaug and Lujala 2005, 404).

Indeed as the recent study by Spagat et al. (2005) demonstrate cross-country datasets of casualty counts generally produce lower figures than finer scale data. An aggregate approach leads to frequent underreporting and necessarily less complexity. It may not be surprising to learn, therefore, that “econometricians have moved steadily from models of nations, and even multinational systems, towards lower levels of spatial desegregation” (Ballas et al. 2005, 27). However, as the graph in Figure 1 suggests, geography at the very local level matters too much to be simulated easily” (Ballas et al. 2005, 117).

RANGES OF SCALES

The above discussion suggests that some scales are more “practical” than others for understanding the complexity of internal conflict. However, this may simply be a superficial argument given that data for analyzing conflict across a range of scales is still limited. In this section we consider the ranges in scale that conflict analysis could take in theory. As in the section above, we focus first on

the issue of time with respect to conflict analysis and then address the relationship between space and conflict using a qualitative approach.

Time. In *A History of Civilization* the French historian Fernand Braudel suggests that history “operates in tenses, on scales and units which frequently vary: day by day, year by year, decade by decade, or in whole centuries. Every time, the unit of measurement modifies the view. It is the contrasts between the realities observed on different time-scales that make possible history’s dialectic” (1962, 34).

Braudel introduces the notion of history as the dynamic interaction of three temporalities. The first of these, the *évènementielle* or ‘individual time’ involves short-lived dramatic events such as wars and revolutions. *Conjunctures* was Braudel’s term for larger, cyclical processes that might span half a century. This is ‘social time’. The *longue durée*, on the other hand, is a historical wave of great length, ‘geographical time’ which is for Braudel the most fascinating of the three temporalities.

Here Braudel focuses on those aspects of every day life that might remain unchanged for centuries to identify “structures” that define the limits of potential social change for hundreds of years at a time. “On this last deep level—civilizations can be seen as distinct from accidents and vicissitudes that mark their development: they reveal their longevity, their permanent features, their structures—their almost abstract but yet essential diagrammatic form” (1972, 35). Abstraction is associated with less complexity albeit less precision as suggested in Figure 1.

Nevertheless, Braudel invites us to reflect on history with a slower pulse-rate and presses historians to look beyond ‘social time’ and charter the larger waves of history. He considers our physical environment as an analogy. Mountains, rivers, glaciers and coastlines gradually shift. “But so slow is this process that none of us can perceive it with the naked eye, unless by comparison with the distant past, or with the help of scientific studies and measurements which go beyond mere subjective observation” (1972, 16).

Here Braudel touches on the issue of complexity and scale in historical analysis. *La longue durée* is to us what the ocean is to fish. We move and breathe through this ether but remain largely unaware of the infinitesimal changes given the high level of abstraction and our lack of precise tools to measure such change on the human time scale. Braudel sees the history of events as a “surface disturbance, the waves stirred up by the powerful movement of tides. A history of short, sharp, nervous vibrations. (...) A world of vivid passions, certainly, but a blind world, as any living world must be, as

ours is, oblivious of the deep currents of history, of those living waters on which our frail barks are tossed” (1980, 87).

Braudel also describes his “history-at-a-distance” approach as “blue-water cruising on the high seas of time, rather than prudent coastal navigation never losing sight of land,” and readily admits that such an approach “has both advantages and drawbacks” (1972, 34). One advantage he ascribes to studying large-scale history is that such an approach “forces one to think, to explain matters in unaccustomed terms, and to use historical explanation as a key to one’s own time” (1972, 35).

At the same time, the drawbacks or dangers of this approach lie in its simplicity. This way of proceeding can “lapse into the facile generalizations of a philosophy of history more imaginary than researched or proved” (35). Certainly, any history which is “pressed to the point of general theory requires constant returns to practical reality—figures, maps, precise chronology and verification” (36). This dialectic suggests that historical analysis might gain from integrating macro and micro time scales.

Space. While political scientists increasingly draw on geographic techniques of spatial analysis, “there is still a significant lag between the disciplines about the concepts of space and time” (O’Loughlin 2004, 4). In this section we explore the concept of space and relate our findings to the study of conflict analysis.

Distance is not purely a geographical term. Sambanis (2002) suggests that distance can be “defined culturally (on the basis of ethnic or religious identity), ideologically, or geographically” (224). Geographers, according to O’Loughlin (2004), “adhere strongly to the notions of ‘place’ as complex areal units that are shaped by human behavior, beliefs and values over a long period of time” (4). The temporal scale that O’Loughlin describes has the semblance of Braudel’s “social time” situated in “social space”. Recall that “social time” is a temporal scale of episodes, each taken as a whole: “Romanticism, the French Revolution, the Industrial Revolution, World War II” (34). Each of these historical episodes were shaped by human agency *and* ‘place’.

“Social space”, like Braudel’s “social time”, may be loosely associated with the modern state or nation-state: a more or less internally autonomous territorial and political unit composing a federation under a sovereign government. A less complex space, one associated with the least complex of Braudel’s three temporalities, *la longue durée*, may correspond to the spatial scale of the

international system. We denote this the “global space” while “individual space” describes the spatial link to Braudel’s “individual time”.

The dialectic between complexity and scale applies equally well to the notion of space. “Social space” is less abstract and therefore more complex than “global space”. This explains why the “mix of characteristics are hard[er] to convey in statistical analyses” at the level of “social space” given the added complexity of human behavior, beliefs and values. “However, it is the spatial paradigm of the geographic discipline (distance, location, continuity, cartographic form and shape, etc) that has been adopted by political scientists. While this is a start in the recognition of the complexity of the world system’s mosaic, it remains a far cry from the preferred region-place approach of most geographers” (O’Loughlin 2004, 4).

What of “individual space”? Within the field of development economics, “the monolithic household most often appears in the form of unitary models of the household. Unitary models are those in which the household is treated as ‘a collective of individuals who behave as if they are in agreement on how to best combine, time goods purchased in the market, and goods produced at home, to produce commodities that maximize some common welfare index” (Carr 2005, 72).

Clearly, “household space” is not “individual space”. As Carr (2005) correctly notes, “despite its common appearance in the mainstream literature,” the household model is “not a particularly useful way of understanding behavior of those living in development contexts because they obscure different preferences and economic orientations within the household” (72). This model assumes that human security is distributed equally among the members of the household.

The household, however, may not be a representative sample of the members; much like our concern with the use of GDP and national casualty counts for analyzing internal conflicts. The tradeoff, of course, is that “household space” is by definition less complex albeit less precise. Ironically the ultimate objective of economic policy is concern over the well being of the individuals. “Yet most policy, and most policy analysis, has until recently equated the well being of individuals with the average (adulty-equivalent) well being of the household to which they belong” (Carr 2005, 72).

In placing almost exclusive importance on the institution of the household for development, practitioners and scholars have “contributed to its indeterminacy by reifying the very institution they seek to analyze” (Carr 2005, 71). Indeed, as Carr adds, “current efforts to get the household right flatten this institution into a fixed object, and in so doing so [sic] miss the relations of power that

produce, and are produced by, the household” (81). As explained earlier, scale determines the occurrence or absence of a certain object class such as the state or the individual. The relative absence of the individual is mandated at the scale of “household” space even though micro-motives are said to inform macro-behavior (Schelling 1978).

What of “global space”? International relations theories such as realism, or neo-realism, “cannot explain why ethnic, religious, or class-based divisions occur in the first place—since it assumes that the state is a unitary actor—and cannot analyze the impact of these actors on the onset of war” (Sambanis 2002, 225). While state failure parallels the anarchic international system and renders neo-realism relevant to the analysis of the dynamics of internal war, “a major difference is that anarchy emerges endogenously in civil war and is not a preexisting structural constant as in the international system. Thus, neo-realism is insufficient as an explanation of the forces that lead to domestic anarch...” (Sambanis 2002, 225).

MULTI-SCALE ANALYSIS

The above discussions suggest that alternative methods for the study of internal conflict are in order. In this session we trace some recent developments and suggest methods from related disciplines that may have the potential to inform the development of methodology for conflict analysis. Unlike the previous sections, we focus almost exclusively on the relationship between space and conflict given the long bias towards studying conflict trends over time.

Buhaug and Lujala (2005) suggest that conflict be the unit of observation. This begs the following question however: what are the corresponding spatial and temporal scales of conflict if this is to be the unit of analysis for conflict studies? Gleditsch and Ward (2001) contend that, “the appropriate spatial variable type depends on the causal mechanism that we believe operates across space and time” (752). This too begs a question: given that social systems are complex and behave in a non-linear fashion across multiple scales in space and time, is it really that reasonable to assume that a (single) causal mechanism can be identified conceptually without any empirical evidence to draw on?

While the authors explore plausible answers the lack of a conclusive solution to the question is unsatisfactory. Where does a conflict start? Some would argue that, ‘wars begin in the minds of men’. As J. Glenn Gray, a philosopher-soldier veteran of World War II noted, “The final secrets of why men fight must be sought beyond the human, in the nature of being itself” (cited in Gupta 2006, 3).

To this end, “understanding the factors that operate in the human mind and at the level of the individual psyche can provide insight into how and why these factors get translated into national/group strategies, interests and movements” (Gupta 2006, 3).

Although sociobiology has taken center stage in this important field of study we seek instead to examine the roots of conflict from a “nurture” perspective. That is, how one’s environment, or space, affects propensity towards conflict and violent actions. That an internal conflict such as a civil war begins in a particular country may be a valid claim this does not necessarily render such description useful given the level of abstraction and spatial imprecision represented.

Gleditsch and Ward (2001) consider the capital city of state as a ‘center’ given that it usually tends to be the most important city of a country and assign those coordinates as the center of a conflict. Then again, the extent to which a capital city is the center of power, and possibly the source of conflict, may depend on the degree to which the capital is able to project across space its monopoly over the use of violence.

In this respect, a “strong” state will project more control within its territorial border than that of a “weak” state. To be sure, strong states have a pervasive influence on society and remain autonomous from other power-holders. In contrast, within most weak states, “the order embodied in the law and authority of the state fades off as soon as we leave the national urban centers” (O’Donnell 1998, 1358). Where does the ‘center’ of a weak state lie?

Gleditsch et al. (2002) provide a more complicated alternative by assigning each conflict a circular zone or *centroid*, defined by a conflict center point (latitude and longitude coordinates) and a radius variable³. While this may be an improvement in precision over the country scale, the circular shape remains a crude and arbitrary approximation of conflict zones. “For example, a civil war may take place mainly along the borders of a country (the Democratic Republic of the Congo), or the conflict zone may be a long by disproportionately narrow area (Peru). In such cases, the circular operationalization by design exaggerates the real zone of conflicts by covering vast areas of unaffected land” (Gleditsch and Ward 2001, 407).

The suggestion made by Buhaug and Lujala (2005) to focus on conflict as the unit of analysis for the study of internal conflict is not a trivial undertaking. While the conflict zone can be used as the base

³ This approach was first suggested in 1942 by the British physicist Lewis Fry Richardson.

unit in some cases, conflict risk analysis “requires a unit of observation that includes null cases (cases without conflict), which renders conflict-specific variables inappropriate” (Buhaug and Lujala 2005, 413). The authors suggest an alternative strategy that uses first-order administrative units (e.g., counties or provinces) as the focal point of data generation and analysis. “Subject to data availability, such a research design facilitates more precise testing of several prevailing theories on causes of civil war...” (Buhaug and Lujala 2005, 413).

Unfortunately, the size and number of units differ greatly from country to country. “For example, most of Niger’s *departments* (first-order sub-national units) are larger than Rwanda and Burundi combined. Hence, it may not be meaningful to divide all countries into smaller units, in particular if the sub-national units do not vary with respect to the dependent variable and the geographical covariates. Moreover, sub-national administrative units are subject to frequent changes” (Buhaug and Lujala 2005, 414). The authors therefore present an alternative strategy that defines a geometric unit, like a 100 km x 100 km grid, as the basis for measurement, and assign values for conflict and the explanatory variables to each cell in the grid.

While this approach admittedly “solves the problem of huge variations in unit size while simultaneously permitting the same detailed level of analysis as the administrative unit approach,” sub-national data and other space-varying factors are “typically given only for administrative units—if available at all—and must be converted to the crude grid format” (Buhaug and Lujala 2005, 414). Moreover, the authors also recognize that “the grid approach is less intuitive than the administrative level, and policy implications will necessarily be less apparent” (414).

Yet another alternative is to employ point pattern analysis (PPA). By using the location of rebel headquarters as the unit, one can “measure the distances from any conflict to nearby conflicts and assess whether the spatial distribution of conflicts differs significantly from a random distribution” (Buhaug and Lujala 2005, 414). This approach facilitates pattern recognition of conflict onset but does not allow studying risk of conflict per se. However, as Buhaug and Lujala (2005) recognize, “conflicts are by nature events that cover considerable areas, and can hardly be described as points even on a small-scale map” (415).

CROSS-SCALE ANALYSIS

In this section we consider a series of novel approaches that address the issue of scale and interdependence in conflict analysis. The following is not meant to be an exhaustive or detailed account of plausible methods on the horizon. Instead, the purpose of this section is to propose a succinct list of action items for future research.

The findings outlined earlier suggest that alternative methods for the study of internal conflict are in demand. Space may indeed be the final frontier in which case the field of conflict analysis requires “advances in our attention to distance and space in theory, as well as improved empirical measures and methods. Most theories of international and comparative politics recognize that political actions, and indeed actors, are interdependent. It is time our empirical analyses reflected this basic fact of politics rather than ignore it” (Gleditsch and Ward 2001, 755).

- Ballas et al. (2005) use a method called “microsimulation” to construct small area population microdata for one point in time and then to update these microdata. This method can be employed to monitor and project trends in socio-economic polarization, and inequalities if past trends were to continue. At the same time, microsimulation enables the exploration of statistics at various geographical scales. One of the major advantages of microsimulation is that it can be a substitute for conducting detailed surveys.
- O’Loughlin (2004) cites recent developments in multilevel statistical modeling that offer a more precise and suitable methodology for examination of contextual factors in political behavior. The data must be collected in a hierarchical manner with respondent grouped into lower-level and higher-level districts. Conflating the levels of analysis takes place when inferences derived from one level of analysis are applied to another, termed the ecological fallacy. Specifically ordering the data in a hierarchical mode allows attention to the interactive effects between levels and promotes a clear understanding of where (which level) and how effects are occurring. In the multilevel modeling, a single regression model handles the micro-scale (individuals), the meso-scale (regions or towns) and the macro-scale (states or countries). Moreover, multilevel models allow relationships to vary across geographic context.

- Bockquier and Maupeu (2004) use a “Lowess smoother” to facilitate interpretation of casualty data at various temporal scales. Lowess fits a polynomial to a set of points but statistically determines whether a point is an outlier and then decreases its effect on the polynomial fit if it is. This serves to “smooth” the curve by ridding the data of any “anomalies”. Given a monthly casualty dataset and two formal data points, month1 and month2, the “Lowess smoother” interprets the most likely casualty rates for temporal data at a finer scale that lies between month1 and month2.
- Turner et al. (2003) present other methodological approaches that may be relevant and applicable to conflict analysis. These include semi-quantitative typologies, complex indicator approaches, integrated modeling and simulation techniques, and statistical downscaling.

SCALE, COMPLEXITY AND POLICY

Ultimately, conflict analysis should inform policy both at the macro and micro level. For example, a macro-policy question might be whether the international community should prioritize conflict prevention or conflict management efforts? At the micro-level, one might ask which policies are better at reducing the risk of violence and in which order should they be implemented? (Sambanis 2002, 238).

Haining (2003) suggests that national politicians are unlikely to be interested in insights from highly localized, micro-level, spatial data analysis while those with responsibility for local problems and local-scale resource allocation are most likely to find this scale of analysis useful. “Local government, grass roots organizations and neighborhood associations as well as local police officials may find insights from micro-scale analyses helpful in identifying persistent high crime areas as well as helpful in pointing the way in terms of how resources might best be targeted” (Haining 2003, 39). These arguments hold for conflict analysis and local prevention. Once the areas at risk are clearly delineated, “the solution to the problem might be as simple as improving street lighting ... or as complex as improving the living conditions of local residents (cited in Haining 2003, 39).

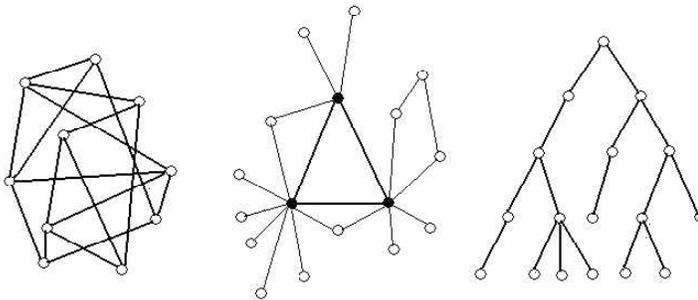
As we have learned, scale and complexity are interdependent. Social systems also demonstrate complex behavior. What are the implications of complexity for policy planning and conflict prevention? “Like any complex social phenomenon, violent conflict does not result from the linear summation of a neatly defined set of causes, but from interactions among multiple phenomena in a

complex system with several levels of organization (...) As complexity and chaos theories show, in such a system behaviors will not respond in a linear way to changes in one variable, however significant that variable may be” (Rubin 2004, 22).

In relation to response, attempting to prevent or solve problems in traditional ways often causes new problems to surface in remote locations or scales. Furthermore, Rubin (2002) suggests that, “preventive action may not work by reversing the value of particular “causes,” but by introducing new factors that change the effects of those factors or transform the system (one way of conceiving of ‘conflict transformation’)” (22). At what scale ought these new factors be introduced? Not surprisingly, the answer to this question has to do with complexity.

Real organizations today are not strict hierarchies but rather hybrids of hierarchies and networks. As Figure 2 show, this hybrid approach provides numerous lateral connections corresponding to communication channels between individuals.

Figure 2



Three types of control structures. Type (a) represents a network; (b) is a hybrid structure while type (c) depicts a hierarchical control structure.

An important observation follows from Figure 2: “to the extent that a single individual is in control of an organization, the organization is limited in complexity to the overall complexity of that single human being (Bar-Yam 2004, 66). To realize why this is an important observation we need to understand why an organization (or indeed any other system) needs to be complex.

Complexity is key to survival since being complex is the only way to succeed in a complex environment, which demands that an organization make the right choice in order to succeed. If there are more possibilities to make the wrong choice than there are to make the right decision, an organization must choose the right ones in order to succeed. As a general rule this requires a high level of complexity. “Although Darwin’s theory of evolution discusses how the fitter offspring tend to survive, the reality is that whether or not an offspring will survive is mostly a function of chance due to the many possible wrong choices that exist for each right choice” (Bar-Yam 2004, 67).

To this end, higher complexity organisms have more behavioral options. This in turn enables them to take more decisions that are correct. “The rule of thumb is that the complexity of the organism has to match the complexity of the environment at all scales in order to increase the likelihood of survival” (Bar-Yam 2004, 67). The same argument can be made in the context of conflict. If the conflict environment of an organization is very complex, many decisions must be made correctly in order to succeed.

While Figure 1 demonstrates the trade-off between complexity and scale, Figure 2 suggests that the success of an organism/organization depends on both complexity and scale. If the conflict environment requires large-scale action and therefore low complexity, a centralized hierarchical administration with a few key individuals is possibly better suited to manage that environment. An example of such an environment might be elements of the international system that tend to change infrequently over long periods but are nevertheless conducive to conflict such as a uni- or multi-polar world order.

Large-scale conflict, in other words, is highly imprecise or diffuse and operates in Braudel’s *longue durée* and across “global space”. The relatively low complexity of a hierarchical control structure and scale at which it operates is therefore a better match with the larger scale environment of the international system. On the other hand, if the environment requires a finer scale of analysis and the management of higher complexity over shorter periods of time then a decentralized federalist administration or network structure is better suited. In this sense, low-scale conflict operates in Braudel’s “individual or social time” and requires a more complex (independent) governing structure to prevent or mitigate conflict escalation.

CONCLUSION

In this paper we asked what the ‘correct’ scales might be to analyze internal conflict. We drew on recent empirical research to demonstrate that conflict is not scale-invariant. We then considered the theoretical ranges of temporal and spatial scales with respect to conflict analysis. Next we identified some novel and potentially promising research methods to model multi-scale and cross-scale relationships. We addressed the issue of complexity and scale for policy. In doing so we demonstrated the importance of relative complexity for selecting the ‘correct’ scale for conflict analysis. Future research should aim to develop a cross-complexity profile or index to measure the coupled organization-environment complexity vis-à-vis social systems and conflict in particular.

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