

THE DIMENSIONALITY OF NATIONS PROJECT

RESEARCH REPORT

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GAME THEORY, FIELD THEORY, AND ATTRIBUTE THEORY:
THREE APPROACHES TO INTERACTION
IN THE INTERNATIONAL SYSTEM

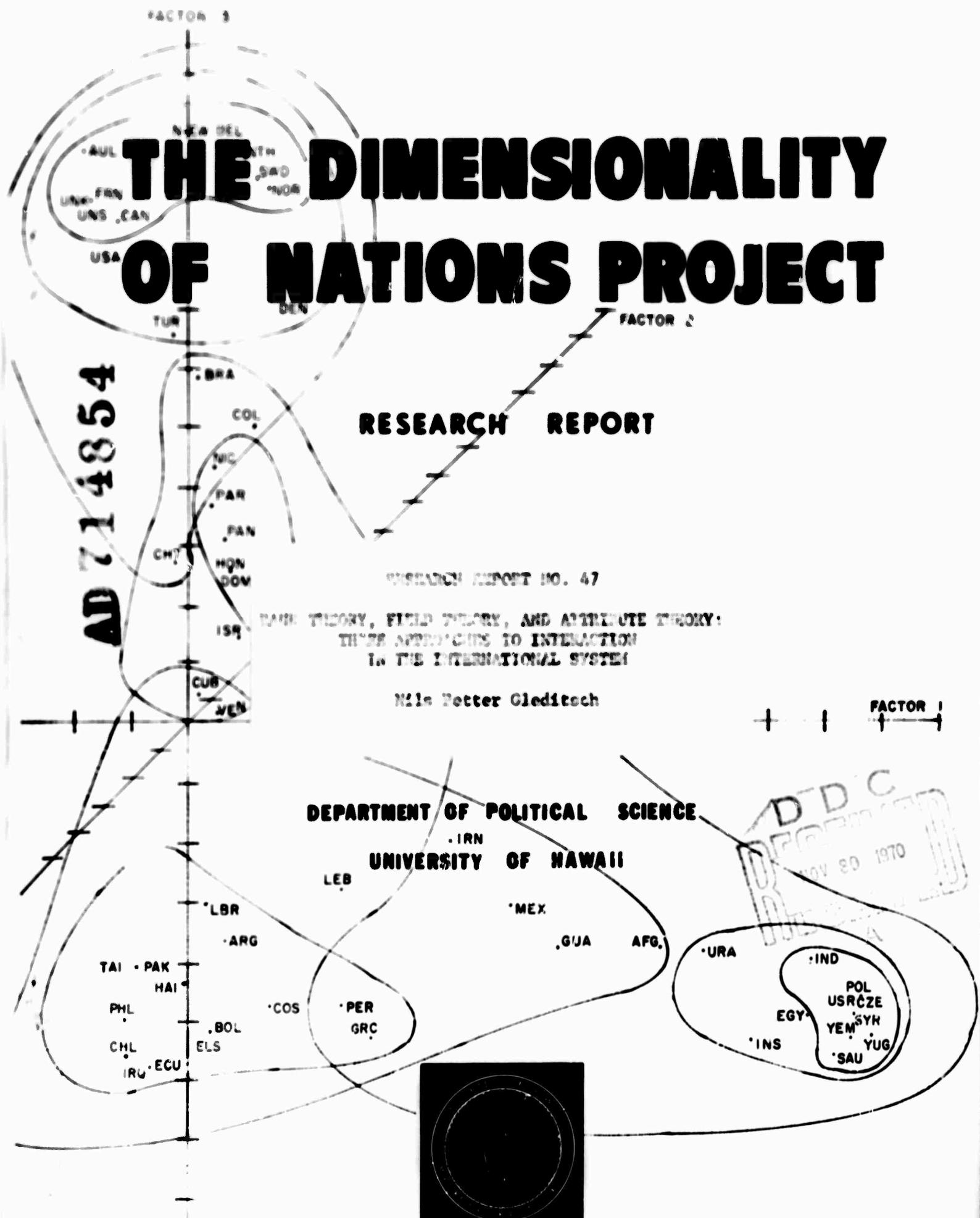
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**The Dimensionality of Nations Project
Department of Political Science
University of Hawaii**

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**PAIR THEORY, FIELD THEORY, AND ATTRIBUTE THEORY:
THREE APPROACHES TO INTERACTION
IN THE INTERNATIONAL SYSTEM**

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RANK THEORY, FIELD THEORY, AND ATTRIBUTE THEORY: THREE APPROACHES TO INTERACTION IN THE INTERNATIONAL SYSTEM

1. INTRODUCTION

Of the many explanations which have been invoked to account for behavior in the international system, rank theory and field theory are two of the most systematic approaches. They also claim greater relevance and applicability than most hypotheses about the international system. There are many contextual similarities: both grew out of dissatisfaction with the paucity of theory in international relations as of the early nineteen-sixties; both draw on traditions in previous writings in sociology and political science, while formulating several hypotheses much more precisely or with clearer relevance to international behavior; neither theory has been expounded at great length in textbook presentations but have to be sought out in scattered journal articles. Finally, both represent something more than a theory: they spearhead research traditions, even movements perhaps, that will be with us for some time. For all these reasons, it is tempting to undertake a comparison of the two, and to apply them to some empirical data about international relations in the post-war period.

Attribute theory, on the other hand, as will be evident from the following, has not been seriously proposed as a theory at all, but serves mainly a contrasting function.

2. RANK THEORY

The central concept in rank theory is that of a rank variable, any attribute on which social units (or actors) rank themselves. For example, occupation and income are rank variables for individuals; size and wealth are rank variables for nations. Two simple assumptions are made, that the units, in this case nations, seek to increase their rank,

and that they seek to balance their ranks, i.e. to obtain rank profiles with as equal ranks as possible. Thus, if we write T (Topdog) for a status of high rank and U (Underdog) for a status of low rank, then the rank profile for the nation is the set of statuses on the relevant rank variables, and TT and UU are balanced profiles while TU and UT are unbalanced profiles. Behind this whole line of thinking lies an assumption that "stratification is multidimensional," that one cannot in general reduce society to a single hierarchy.

This is not the place for a formal exposition of rank theory, and a derivation of the specific propositions to be tested in this article. Suffice it to say that five main propositions about inter-nation behavior have been found in the rank theory literature. These are the following:¹

- H.1. The higher the total rank of two nations in a pair, the higher the interaction in the pair.
- H.2. The higher the similarity of the total rank of two nations in a pair, the higher the positive interaction in a pair.
- H.3. The higher the similarity of the rank profiles of two nations in a pair, the higher the positive interaction in the pair.
- H.4. The higher the rank incongruence of two nations in a pair, the lower the positive interaction in the pair.

¹The propositions were mainly culled from the writings of Johan Galtung, in particular 1964, 1966a and 1966b. This is by no means to say that this set of five is exhaustive or even theoretically reasonable. Nor is it derivable from a set of simple assumptions. Another article (Gleditsch, forthcoming) attempts to restate the theory in greater detail and rigor.

11.5. The higher the joint rank disequilibrium of two nations in a pair, the higher the negative interaction in the pair.

The first hypothesis is relatively straightforward. It implies that topdog nations have the highest interaction frequencies between them, next we find the topdog-underdog pairs of nations, and the underdog-underdog pairs of nations rank lowest in terms of interaction frequency. By interaction between two nations we refer to behaviors of all kinds, whether cooperative or conflict behavior.²

The first hypothesis follows from the assumption about balance if we regard behavior itself as a rank variable. This becomes clearer, perhaps, if we think of activity or "activeness" as a rank variable, and the magnitude of behavior as one manifestation of activity. Then, in order to maintain balance between what we might call "attribute rank" and "interactive rank," the rich and the wealthy nations must also be high on activity. This creates a link at the nation level: the higher the rank of a nation, the larger its behavior. Then, if we make no special assumptions about particular pairs, it follows that high-ranking pairs (summing the ranks of the two nations in the pair) should have higher interaction.

The second and third hypotheses both originate outside rank theory proper, in the sociological tradition of "homogamy." The idea is simply that the more similar two units are, the more they tend to interact. This proposition is well established in processes like the selection of

²We prefer to use "behavior" with reference to nations and "interaction" with reference to pairs of nations. Thus, the trade between Guatemala and Togo is an indicator of interaction between them, whereas the total trade of Guatemala is a form of behavior on Guatemala's part. Behavior is sometimes called total interaction; interaction is sometimes called dyadic behavior or transactions. In Rummel's work, behavior usually refers to dyadic behavior.

friends³ and marriage rates⁴ but little, if any, work has been done for the international system in this perspective. Notice that the propositions relate only to similarity on rank variables. Furthermore, most work in sociology has predicted to interaction from similarity on a single rank variable: similarity can then be defined unambiguously. In a multidimensional stratification system, there are at least two meaningful concepts of similarity: the similarity of an over-all or average rank, or the average similarity of all one's statuses. Clearly the latter type of similarity is a stricter condition. If two nations in a two-variable stratified system have profiles TT and UU they have perfect similarity on both measures. If, on the other hand, they have the profiles TU and UT, the similarity of total rank is at a maximum, while the similarity of the rank profile is at a minimum. The concept of similar total rank is closer, theoretically, to the concepts of similarity used in research on single-variable stratification systems since the single variable is usually taken as an indicator or a more general concept of rank or is a composite variable (an additive index, a scale or factor score, etc.). The idea of linking positive interaction to rank profile similarity, however, seems theoretically more meaningful. A common status provides a link around which one can build a meaningful relationship. We retain both hypotheses, but with the expectation that the latter will prove more fruitful.

The fourth hypothesis is a little more complicated. The concept of rank congruence is developed as follows: Pick any one of the rank variables, and compare the two nations' rank on the variable. Then take the other rank variables one by one and if the rank order between the two nations is the same for all of the variables, the pair is congruent. If not, we have rank

³See e.g. Kerckhoff, 1963; Ramsby, 1966; and Eckland, 1968.

⁴See e.g. Loether, 1960.

incongruence. The idea is that in the case of rank incongruence, two nations do not have an unambiguous basis for comparing each other. The less they interact, the less they have to compare. Rank incongruence is therefore hypothesized to lead to withdrawal or lack of positive interaction on the part of the two nations.

The fifth hypothesis contains a related idea in that it also makes use of the multidimensionality of the stratification system. Here, a nation makes comparisons within its own set of statuses. We have argued previously that nations seek balanced rank profiles. Ordinarily, since nations also seek to increase rank, if a nation finds itself with an unbalanced or disequibrated rank profile, it would attempt to balance it upwards by changing the low status into a high. But what if peaceful change is impossible? Then the hypothesis is that the nation will become aggressive, and try to change the structure -- or its own position in it. Again, this is a hypothesis at the nation level. The more disequibrated a nation, the more aggressive. And again, if we make no special assumption about the distribution of this aggressiveness over particular pairs, it follows that the higher the joint disequilibrium in the pair, the higher the aggressiveness in the pair. The problem is that since we do not know how to measure aggressiveness directly, and we want to compare this to another theory about foreign conflict behavior, we have to make the further assumption that the occurrence of foreign conflict behavior is proportional to the aggression in order to obtain hypothesis five. This assumption is a weak link in the chain. If we assumed that conflict behavior was always initiated by an act of aggression, and a defensive response of equal magnitude followed the aggressive act, then half of all foreign conflict behavior would be unrelated

to aggression! On the other hand, this is a naive model of conflict. It seems theoretically more plausible that the amount of conflict behavior in the pair is dependent not only on the initiation of aggression by one party but also on escalatory or conciliatory responses on the part of the other (and then, again, on the part of the first, etc.).

In summary, then, we make the following specific predictions within rank theory (Figure 2.1).

Figure 2.1 Rank Theory Summarized

Parameter of the pair	Inter-nation interaction	
	Positive	Negative
Total rank	x	x
Similarity of total rank	x	
Similarity of rank profile	x	
Rank congruence	x	
Rank disequilibrium		x

An extension of the rank disequilibrium hypothesis was made by Jackson (1962, 1965), who suggested the introduction of the distinction between achieved and ascribed rank into this theoretical argument. If a disequilibrated nation is high on achieved rank, i.e. his high status is earned, or perceived to be earned, and low on ascribed rank, i.e. his low status is one he was born with, or one which has been given to him or defined for him by the system, we have a case of over-achievement; the nation has achieved more than its "station" in life. If the rank profile is reversed, however, i.e. high ascribed rank, low achieved rank, we have an

under-achiever. Jackson's hypothesis is that an over-achiever will turn his aggression outwardly on the system. The under-achiever, however, will turn his aggression inwardly upon himself. Or, in other terms, the over-achiever will be extra-punitive, the under-achiever will be intra-punitive.

This is a distorted point in rank theory. Just as over-achievers, such as students, are known to be more radical (i.e. outwardly aggressive) they are also known to suffer more from nervous diseases and have a higher suicide rate (i.e. to be inwardly aggressive).⁵ On the other hand, the outward aggression of white under-achievers against upwardly mobile Negroes in the United States is also well known. For similar reasons Galtung (1964) rejects Jackson's suggestion, only to accept it in a later article.⁶

A major weakness of this version of rank theory is that it says nothing about asymmetries in interaction. We have been referring to interaction between two countries A and B but what about the constituent parts of that interaction, A to B and B to A?

There is no theoretical reason, considering the brief presentation of the theory above, why the first four rank concepts should not relate to interaction both as received and as sent. Moreover, we would expect the two components of a sum to be highly related to the sum, so that in terms

⁵A case in point is Japan with high student activism as well as high rates of student suicides. There is anecdotal evidence from several countries that these forms of "aggression" hit the same individuals, i.e. that nervousness and suicides etc. are particularly frequent among student activists. Feuer (1969), however, argues that outward and inward aggression to some extent represent different temporal phases of the same movement. To our knowledge, there has not been any major empirical study of this.

⁶See propositions 2.1.1 and 2.1.2 on p. 142 in Galtung, 1966.

of empirical analysis the difference might not be great. This is all the more so because interaction in the international system tends to be asymmetric.⁷ In the case of complete symmetry of interaction, of course, it makes no difference at all whether we analyze total pairwise interaction or sending and receiving separately.⁸

Even so, we deprive ourselves from the very beginning of the possibility of explaining that part of international interaction which is asymmetric. This is not a necessary feature of rank theory. At the small group level, the hypothesis relating total rank to total interaction has been supplemented with a hypothesis stating that the higher the total rank of a group member the higher his total initiated interaction.⁹ Even more relevant is the following proposition at the pairwise level from Berelson and Steiner (p. 348): "there is more interaction from high to low than from low to high." Empirical evidence for this is found in Murditz, Zander, and Nymovitch (1960). (This proposition is also quoted in Galtung, 1968) The major stumbling-block to a translation of this hypothesis to the international level is the question of what constitutes the direction of interaction. In small groups the number of notes (including verbal statements) issued from one person to another has been used as a measure. For certain forms of

⁷The appropriate measure of symmetry of interaction would be an agreement measure (cfr. Robinson, 1957), but this has not, to our knowledge, been computed for any form of international interaction. However, the correlation between imports and exports for the world as a whole has consistently been found to be very high. Richard Wadwick has found an r of .93, for instance. A grouping of dyads on the basis of their foreign conflict behavior (Rummel, 1967a, p. 203) gives an impression of a high degree of symmetry.

⁸Some forms of international interaction are, of course, completely symmetric--e.g. the number of flights per week, diplomatic ties, etc.

⁹Cfr. proposition 9.3., p. 171, in Collins and Guatzkow, 1964.

interaction in the international system it is relatively clear what "number of acts" means. Thus, one hypothesis might be that there is more foreign conflict behavior directed from topdogs to underdogs than vice versa,¹⁰ another that more technical aid is given from topdogs to underdogs than vice versa, etc.¹¹ However, what about trade? Is there any theoretical reason for assuming that topdogs should export more to underdogs than vice versa? Should we expect topdog countries to send more foreign students to underdog countries because topdog countries are more active generally, or should we expect underdog countries to send more foreign students to topdog countries because the underdogs are more eager to learn from the topdogs and imitate them? All in all, the problem of asymmetry raises so many unresolved theoretical issues that we prefer not to introduce it here.¹²

Finally, we set out the hypotheses of rank theory in equation form:

$$P_{ij} = c_1 + b_1 T_{ij} - b_2 DS_{ij} - b_3 PD_{ij} - b_4 IC_{ij}$$
$$N_{ij} = c_2 + b_1 T_{ij} + b_2 DE_{ij}$$

where

T_{ij} is positive interaction in the pair

N_{ij} is negative interaction in the pair

¹⁰Gallensteen's study of economic sanctions presents empirical information consistent with this hypothesis: there are more sanctions directed from large to small nations than vice versa.

¹¹This hypothesis hardly needs statistical evidence marshalled in its support.

¹²Thus, in a list of seven major propositions in rank theory and several subpropositions in Galtung, 1966b, considerations of asymmetry only enter with respect to rank disequilibrium.

and

T_{ij}	total rank of the pair	$a_1 + a_2 + b_1 + b_2$
DS_{ij}	total rank dissimilarity	$ a_1 + a_2 - b_1 - b_2 $
PD_{ij}	rank profile dissimilarity	$ a_1 - b_1 + a_2 - b_2 $
IC_{ij}	rank incongruence	$ a_1 - b_1 - a_2 + b_2 = (a_1 - b_1) - (a_2 - b_2) $
DE_{ij}	disequilibrium of the pair	$ a_1 - a_2 + b_1 - b_2 $

where a_1 and a_2 are the i -th nation's scores on the two dimensions and b_1 and b_2 the j -th nation's scores.

3. FIELD THEORY

So far as we are concerned with it here, field theory consists of one statement, or "basic theorem," namely that

$$W_{ij} = \sum_{k=1}^m \alpha_k d_{ijk} \quad (1)$$

where W_{ij} is interaction directed from i to j , $\sum_{k=1}^m$ summation for m independent dimensions, α_k a constant and d_{ijk} the difference between the values of the nations in the pair (i, j) on the k -th attribute dimension. In verbal terms, differences on attributes between interacting nations predict to their interaction.

Attributes and behaviors are conceived of as two multi-dimensional spaces. Field theory, then, hypothesizes a mapping of dimensions of attribute space into behavior space. The independent dimensions of the two spaces are found by factor analysis.¹³

¹³The basic, mathematical statement of field theory is in Rummel, 1965. For recent developments in field theory see Rummel (1969a) and McCormick (1969). The latter presents a dynamic version of field theory, which we shall not go into at all. -- For a much more general treatment of field theory, without reference to international interaction, see Mey (1965).

A verbal justification for field theory, drawing on an analogy with small group behavior has also been given by Rummel: "Place an individual in different groups and his behavior will shift as a function of his personality differences with members of the group. That is, relative distances on personality dimensions between individuals influence behavior more than the actual characteristics themselves. Likewise, for nations it is social, economic, political, and geographic distances that influence international behavior. Differences in technological levels, values and the perception of international order related to the 'moves' that nations direct toward each other."¹⁴

Field theory is not equivalent to saying that "similarities are associated with positive interaction, differences with negative interaction." Field theory says nothing about the direction of the relationships. If all conflict dimensions were highly and positively associated with high similarity on the attribute dimensions, this would be consistent with field theory. More realistically, in empirical applications we would expect similarity on some attribute dimensions and differences on other dimensions to be associated with some dimensions of negative interaction, etc. On the other hand, the lack of a specified direction does not make Rummel's field theory tautologous: it only means that the criterion for rejection is a low association whereas the hypothesis relating rank profile similarity to interaction can also be rejected if the relationship is strong, but reversed.

In applications of field theory (e.g. Rummel, 1966), d_{ijk} , i.e.

¹⁴Rummel, 1967a, p. 214.

the square of the distance on the attribute dimensions has sometimes been substituted for the directional vector d_{iju} . The effect of this change is quite important, as a simple example will indicate. For 1956 the U.S. national income is recorded in the JON data as \$350.8 billion; for 1955 the figure for the U.S.S.R. is 44.5 billion. The directed difference US - USSR is 306.3 billion. If field theory were to fit the data exactly, the behavior of the U.S. towards the U.S.S.R. must be directly "opposite" to that of the U.S.S.R. to the U.S. Yet, their behavior at the time was relatively symmetric, both in terms of conflict and cooperation. Squaring the attribute difference, however, makes the "attribute distance" symmetrical, and would give a better prediction to relatively symmetrical behavior.¹⁵

It is debatable whether d^2 is deducible from the axiom of field theory relating the attribute and behavior spaces.¹⁶ If it is not, then a weakness of the theory is that no theoretical argument has been given for a theory in terms of d versus one in terms of d^2 . Indeed, there are many other functions of attributes which might be used instead of the signed or squared differences, such as the sum or the squared sum. Replacing d with any other function would still be "field theory" in a loose sense, although it would no longer be the field theory proposed by Rummel. Even so, this would not be tautological, since we could have no guarantee that any function

¹⁵See Rummel, 1969a, pp. 18f.

¹⁶See Rummel, 1965.

of attributes would be highly associated with interaction.¹⁷ But since the number of permissible functions of even a single attribute dimension is infinite, field theory even in this loose sense would not be falsifiable. We shall avoid this problem here by referring instead to four models of field theory (cfr. Figure 3.1.)¹⁸

Figure 3.1 Models of Field Theory

Model	Behavior accounted for by
a	signed differences on attribute dimensions
b	squared differences on attribute dimensions
c	sums on attribute dimensions
d	squared sums on attribute dimensions

It should also be noted with respect to field theory that models b, c, and d are intrinsically just as incapable as rank theory of accounting for the asymmetric part of interaction.

¹⁷In fact, some theorists of international relations (such as Charles McClelland and Karl Deutsch) would probably argue that behavior originates at the systemic level, and is not a (perfect) function--any function--of attributes. This is seen clearly in the null model of international transactions as developed by Savage and Deutsch (1960) and others. The idea is not to use this model to predict trade flows, but to filter out one of the more obvious sub-systemic effects, namely that of differential size, in order to get at the systemic aspects of international flows. Here we might even think of three broad schools of international relations, in terms of attributes (e.g. the power or realist school), in terms of functions of attributes (rank theory, field theory), or in terms of systemic relations only (general systems theory). See also McClelland, 1968 for a discussion of field theory vs. systems theory. At the small group level, systems theory has a parallel in attempts to explain rates of participation without reference to actor characteristics. (Cfr. Kadane and Lewis, 1969 and references.)

¹⁸Unless this restriction was made there could be no comparison of field theory and rank theory. For the rank parameters are functions of attributes and rank theory is thus contained within field theory in the broad sense.

Finally, a more recent version of field theory has been proposed by Rummel (1969b). In our terms, the model is

$$W_{ij} = \sum_{k=1}^m \alpha_{ik} d_{ijk}$$

where α_{ik} is a constant not just specific to the dimension, but also specific to the actor. In verbal terms: the behavior of a dyad is influenced by the distance on attribute dimensions weighted by a parameter of the nation. This model, called model II by Rummel, will be discussed briefly in the next section. The empirical work, however, will be limited to "model I" (sub-models a, b, c, and d). (For empirical results reported by Rummel, see Rummel, 1969a, p. 35a).

4. ATTRIBUTE THEORY

There is, of course, no such thing as "attribute theory." The need for its introduction here stems from two incidents in the intellectual histories of the two other theories.

Field theory was developed, in part, in opposition to the idea that conflict could be predicted directly from the magnitude of attributes. Thus, Rummel (1967a) tested eleven hypotheses relating attributes such as economic development, power, instability, no. of borders, etc. to foreign conflict behavior by nation. He concluded that by and large there were no strong associations for any of the hypotheses considered.¹⁹ He then went on to suggest "that the lack of correlation is due to the initial question which framed the relationship as one between magnitudes in the two systems. This is the same as saying that the total behavior of an individual

¹⁹We shall return below to a reconsideration of some of Rummel's data on which this conclusion was based.

in a social group is highly related to his personality characteristics."²⁰
He then suggested field theory as an alternative.

What we call attribute theory here, then, is in one sense merely a straw man whose role we may eliminate before we go on to consider the theories which have been seriously proposed.

In a sense, attribute theory may be said to be "curve-fitting," --testing hypotheses which are merely thrown in for the test and not theoretically derived. This is an argument against contrasting it with rank theory, but hardly against a test of field theory, since attribute theory could easily be formalized in exactly the same way field theory is. In fact, to change field theory into attribute theory one need only replace distance by the magnitude of attributes in statements 5 and 6 of the theory (Rummel, 1965, p. 185, pp. 202f). The basic equation would then read:

$$W_{ij} = \sum_{k=1}^m \alpha_k s_{ik} + \sum_{k=1}^m \beta_k r_{jk} \quad (2)$$

where α_k and β_k are constants, s_{ik} is an attribute of the sender i and r_{jk} an attribute of the receiver j , both in the k -th dimension. What is more, it can easily be shown that field theory models a and c are nothing but attribute theory with some restrictions on the possible empirical coefficients. For, since field theory specifies that

$$W_{ij} = \sum_{k=1}^m \alpha_k d_{ijk}$$

where (in model a) $d_{ijk} = s_{ik} - r_{jk}$, the field theory equation implies

²⁰Rummel, 1967a, p. 213f. It is a different matter whether one agrees that the statement used to reject attribute theory by a reductio ad absurdum argument is wrong.

equation (2), the attribute theory equation, with the restriction that $\alpha_k = -\beta_k$ for all k dimensions. Similarly, for model c, field theory is attribute theory with the restriction that $\alpha_k = \beta_k$ for all.²¹ Thus, only models b and d of field theory are at all distinguishable from attribute theory.

This implies that models a and c can be chosen over attribute theory only on non-empirical grounds, such as theoretical simplicity, etc. In general, if one applies attribute theory to empirical data, at least one α_i will be different from the corresponding β_i and the restrictive condition of field theory will not give the best fit.

The interesting aspect of models b and d, in this perspective, is that both assert that the attributes of the sender and the receiver interact to influence behavior. Numerous other functions of s and r do this, of course, including the absolute difference.

Rummel (1969a) has discussed another version of attribute theory, which relates attributes to behavior by nation (not dyadically). In our terminology, the model is

$$W_i = \sum_{k=1}^n \gamma_k s_{ik}$$

He concludes (pp. 13, 16) that if and only if for all k , each of the α_k 's of the field theory equation equal $\frac{1}{n} \cdot \gamma_k$ (where n is the number of

²¹Strictly speaking, attribute theory would require absolute values, while field theory requires relative values (factor scores). However, since the transformation is linear, this makes no difference. Another potential difference, that field theory is concerned with dimensions, attribute theory with variables is also eliminated, since--as pointed out above--we are using marker variables as indicators of the factors.

nations). The reader can easily verify that if this (very restrictive) condition holds, attribute function at the dyadic level sums up to the by-nation attribute function plus a constant.

It should be noted that model II is subject to exactly the same problem. We may set d_{ijk} equal to $s_{ik} - r_{jk}$ again, and the model II field theory equation then reduces to an attribute theory equation (although a different attribute theory equation than the one previously presented) in the sense that there is no interaction between the attributes of sender and receiver. We obtain

$$W_{ij} = \sum_{k=1}^m \alpha_{ik} s_{ik} - \sum_{k=1}^m \alpha_{ik} r_{jk}$$

Rummel now tests this equation for each sender nation separately. A feature of this model is that for each test i is constant, hence the whole term $\sum_{k=1}^m \alpha_{ik} s_{ik}$ is also a constant. The equation then reduces to

$$W_{ij} = k - \sum_{k=1}^m \alpha_{ik} r_{jk} \quad 22$$

or, in verbal terms: The behavior of a nation towards other nations generally is a function of its own attributes. Any difference in behavior towards two other nations is exclusively a function of the other nations' attributes.

Finally, a problem of this model is that for n nations each of the n equations only has $(n - 1)$ degrees of freedom, whereas in the rank theory, field theory, and attribute theory equations tested here, the dependent variable has $n(n - 1)$ degrees of freedom.

Even when it comes to "theoretical simplicity"²³ the arguments may

²²Cfr. Rummel, 1969b, p. 32f.

²³For the criterion of simplicity, see Kaplan, 1964, p. 316ff. Rummel lists "rigor, simplicity and beauty, comprehensiveness and deductive fruitfulness" as important criteria (1969b, p. 21).

be in favor of attribute theory, rather than field or rank theory precisely because it does not require that the attributes of sender and receiver interact. This point has been made many times in the discussions of the identification problem in research on rank disequilibrium (status inconsistency, imbalance, etc.).²⁴ It may be argued on theoretical grounds that there is no reason to hypothesize a more complex, interactive relationship between attributes and e.g. aggression (or whatever of the numerous consequences attributed to rank disequilibrium) if a simple model in terms of two additive (main) effects will account for exactly the same part of the variation. The problem here is exactly parallel, although in field theory we are dealing with the interaction effect of the values of two units on the same variable, whereas the rank disequilibrium hypothesis deals with the interaction effect of one unit on two variables.

Finally, an attractive aspect both of field theory and rank theory is their generality. But their claim to an all-encompassing explanation of human behavior should not blind us to the existence of many interesting hypotheses which claim a more restricted applicability. One of these concerns the relationship between foreign and domestic conflict.

A well-known proposition from Simmel and reformulated and clarified by Coser (1956) states that conflict with an out-group will increase in-group cohesion and diminish in-group conflict behavior unless the group was already so disintegrated that conflict from the outside made it fall apart altogether.²⁵

²⁴See e.g. Blalock (1967), Hernes (1969), Fossum (1969) and Galtung (1969).

²⁵Coser, 1956, p. 87ff.

The theoretical idea is simple, yet attractive. When a group is threatened from the outside, it shelves its internal conflicts for the time being. Whatever the issues involved in domestic conflict they usually seem less serious and the domestic enemy less threatening in the perspective of conflict with an outside enemy. Apparent examples of this in international relations are abundant. The six day war between Israel and the Arabs in 1967 afforded the example of Dayan's entry into the government and a wave of national unity, as well as a dramatic declaration of solidarity between the previously hostile leaders of Jordan and the UAR. The temporary reconciliation between the Chinese communist party and the Kuomintang in the face of the Japanese occupation is another famous example. And the effects of domestic sanctions can be considered in the same perspective.²⁶

In spite of the seemingly good reasons for accepting this hypothesis, there is little systematic empirical evidence for it. The point that is relevant here is merely that internal conflict is also a "national attribute" and such hypotheses as these may also be included as part of "attribute theory."

In conclusion, then, attribute theory is a "straw man," a simple "alternative model," a set of "third variables" which should be "controlled for," a way to make sure that we do not invoke very subtle concepts in connection with empirical data which are just as consistent with much simpler (if not outright trivial) concepts unless we have good theoretical reasons for doing so. Within attribute theory, there are several specific hypotheses for which sound theoretical reasons can be advanced. Our main interest here, however, will be to compare the straw man with the two theories.

²⁶Galting (1967) suggests that economic and other sanctions will unify the nation hit by them, at least up to a certain point.

It should be noted that "attribute" theory can account for asymmetric interaction, since the attributes of sender and receiver enter separately.

5. PREVIOUS EXPERIENCE

There is relatively little relevant material for the international system.

A study by Fossum (1967) analyzed the relationship of rank disequilibrium (under-achievement) to military coups. Hernes, in a critique already cited, found little support for any interaction effect over and above the two main effects of "large" and "poor."

The relationship between attributes and foreign conflict behavior has also been examined in several publications from the DON project. Rummel (1964) found multiple correlations ranging from .33 to .49 for 13 foreign conflict variables when four dimensions of attributes²⁷ and three dimensions of foreign conflict were used as independent variables. If the domestic conflict variables had been excluded, the multiple correlations would have been lower. None of the bivariate or partial correlations between attributes and foreign conflict behavior were above .3. However, Rummel's main conclusion in this article was that, at least as far as war was concerned, "demographic conditions" seemed to predict better than "technological conditions." Then the factor analysis of the 236 variables was performed and foreign and domestic conflict appeared as distinct factors separate from all the attribute factors, such as size, wealth, and politics.²⁸ In part building upon this

²⁷These were dimensions found by Berry (1961). The factor analysis of the DON attribute data for 1955 had not yet been performed.

²⁸Cf. Sawyer, 1967. For a much more extensive report, see Rummel, forthcoming, a.

finding, in part upon an examination of the bivariate correlation matrix, Rummel concluded that attributes and foreign conflict were unrelated (Rummel, 1967a).

Wallensteen's study of economic sanctions, on the other hand, indicates that large nations tend to initiate more economic sanctions. The smaller and poorer nations which have initiated sanctions (e.g. the black African countries against Portugal and South Africa; the Arabs against Israel) try to compensate for their smallness by joining together in applying sanctions. This could, of course, be cited as evidence for either rank theory or attribute theory. However, Wallensteen's number of cases is rather small, and sanctions are not necessarily typical.²⁹

With regard to field theory, however, only two relatively preliminary articles have been published so far. The first (Rummel, 1965) is mainly theoretical and does not test any of the models 1 - 4. The second (Rummel, 1966) regressed seven squared distances on attribute dimensions plus two measures of geographical distance (inter-territory and inter-capital) plus the squared joint power³⁰ of the two nations upon four foreign conflict variables and two measures of the overall magnitude of foreign conflict behavior. The results, for 91 dyads, ranged from a multiple correlation of .5 for "hostility" to .34 for "violence" and .38 for the calculated magnitude of all foreign conflict. In other words, they were encouraging,

²⁹Wallensteen (1968) lists eighteen 20th Century cases of economic sanctions, ten of which he studies more intensively. Our conclusions apply to both samples.

³⁰The "joint power" measure really belongs to model 4 since it involves the square of a sum of attributes. Strictly speaking, geographical distances, if they belong in field theory at all, must be considered part of model 1 rather than model 2. However, the author makes the appropriate reservations about this first preliminary effort to test field theory.

but only marginally better than the by-nation analyses of the relationship of attributes to foreign conflict.³¹

For tests of rank theory and foreign conflict behavior we again have to look to the publications of the DON Project. In the article testing field theory Rummel noted, on the basis of Galtung (1964) "with some revisions" that "there is a rank disequilibrium encouraging tension between those differentially high on the three attributes" (of economic development, power, and prestige). He then proceeded to test this by means of the distance on the rank dimensions. He argued that the rank disequilibrium effect of the power distance may be cancelled out by an opposing factor: if A is much stronger than B, then B is likely to give way to A before foreign conflict behavior becomes necessary. This reasoning, Rummel argued, is consistent with the finding that distance on the economic development dimension turned out to be significant (partial $r = .22$) whereas power distance was not. However, the flaw in this argument is that a squared distance between two nations on one rank dimension clearly is not the same as rank disequilibrium which is a "distance" between one nation's score on two (or more) dimensions.

A second article by Rummel (1967b) analyzed conflict data by nation, and this test is more satisfactory for our purposes. Here, the interesting finding emerged that there was a second-order factor, which

³¹Although most inter-correlations between attributes and foreign conflict variables were small, there was not a single one of the conflict variables which did not have several correlations above .3 with attributes. The single largest such correlation was .57 between defense expenditure as a percentage of GNP and accusations. Multiple correlations were not reported. (Rummel, 1967a, pp. 188-99).

included high wealth, low size and high foreign conflict.³² This is certainly consistent with the rank disequilibrium hypothesis, but the interpretation of higher-order factors is somewhat unclear. And we cannot get an answer to the crucial question of how much of the variation in foreign conflict behavior is accounted for by disequilibrium, as distinct from "smallness" or "richness" alone.

Recently, Gurr has developed a similar model, relating "relative deprivation" to foreign conflict behavior. Some preliminary, but promising, results are also available for this model (Gurr with Ruttensberg, 1967; Gurr, 1970).

When it comes to the prediction of positive interaction or cooperative behavior from rank, much more evidence is available. Here, of course, there is a long list of studies in small groups, communities, etc. to draw upon.³³ But even in international relations it can be stated with considerable confidence that the relationship between total rank and total interaction is well established, at least at the nation level. Thus, in the DON Project, several behaviors have come out on the two major rank dimensions of size and wealth (Tables 5.1, 5.2). In fact,

³²Second-order factors are "dimensions of dimensions." They may be found by a factor analysis of obliquely rotated dimensions (i.e. correlated factors) or of correlated marker variables for independent dimensions. For a discussion with substantive examples and suggestions for the interpretation of higher-order dimensions, see Rummel, 1970, ch. 18.

³³See, e.g., Riecken and Homans (1954) or Collins and Guetzkow (1964), particularly ch. 9, for reviews of some of the relevant literature.

all the variables indicating the presence/absence or magnitude of some international interaction have loadings above .4 on one or both of these dimensions, except two: "UN technical assistance fellowships in country" and "balance of investments."

This does not mean, of course, that all the variation in the interaction variables has been accounted for these two dimensions. But in terms of the broad pattern of cross-national variations, these are the two most important dimensions linked to interaction. And no separate factor is found which can be identified as dimension of positive interaction. Both in the case of dimension nine ("foreign students") and of dimension eleven ("traders") the variable loading most highly on the dimension is a relative interaction variable (foreign college students/college students and exports/GNP respectively), but the corresponding absolute interaction does not appear on the eleventh factor and only reaches .44 on the ninth.

Work on the international airline network has indicated strongly that total rank is related to this particular form of interaction, both for the nation as a whole and at the pairwise level (Gleditsch, 1967, 1969). The same has been shown for diplomatic exchange and membership of international organizations at the global level and for various other forms of positive interaction for regional sub-systems of nations, particularly Latin America (Galtung et al., 1965; Schwartzman, 1967) and Europe (Galtung, 1966c). Little work has been done, however, to determine whether specific rank variables are particularly important in relation to specific forms of interaction. And to our knowledge, no empirical work, except one parallel effort by this author (Gleditsch, forthcoming), has been done with the rank concepts

Table 5.1 The Size Dimension and Interaction, 1955*

<u>Interaction variable</u>	<u>Loading</u>
Exports	.88
Trade	.87
Embassies and legations in other countries	.80
Contributions to technical assistance	.78
Representatives to the UN	.77
Foreign students in country	.74
Foreign mail	.69
Embassies and legations from other countries	.59
Treaties	.57
Military treaties	.51
UN technical assistance fellowship recipients in country	.49
International non-governmental organizations memberships	.48
Immigrants	.47
International organizations headquarters in country	.47
International organization memberships	.42
Multilateral treaties	.41

Source: R. J. Rummel. "Oblique Rotated Factor Tables for 236 Variables," 1965. Also in Rummel (forthcoming, a).

*Note that Table 5.1 and 5.2 give loadings with the oblique (non-independent) dimensions, whereas later the independent dimensions will be used. However, for the 1955 attribute data there is not a great deal of difference and most of the fourteen basic indicators can serve as indicators of either oblique or orthogonal (independent) dimensions. Moreover, since the oblique dimensions have small intercorrelations, the loadings in Tables 5.1 - 5.2 can be loosely interpreted as correlation coefficients.

Table 5.2 The Wealth Dimension and Interaction, 1955

<u>Interaction variable</u>	<u>Loading</u>
International non-governmental organization memberships	.80
Trade	.76
Foreign Mail	.73
International organization headquarters in country	.72
Foreign Visitors	.72
Exports	.71
International organization memberships	.70
Multilateral treaties	.68
Treaties	.66
Foreign students in country	.64
Embassies and legations in country	.61
Embassies and legations in other countries	.63
Contributions to technical assistance	.84
Balance of official donations	.40
Technical assistance received	-.73
Economic aid received	-.80

Source: See Table 5.1

predicting to positive interaction other than total rank (rank similarity, rank congruence). Thus, in spite of the starting-point of rank theory, that stratification is multi-dimensional, little use has been made of the multi-dimensional rank concepts except for rank disequilibrium.

In short, then, there is some evidence linking field theory to behavior generally, considerable evidence linking total rank to positive interaction, and little, if any, evidence at all for the other rank concepts as far as the international system is concerned. Even more importantly, there has never been any attempt to compare the two approaches, and to compare both with the straw man that we have called "attribute theory."

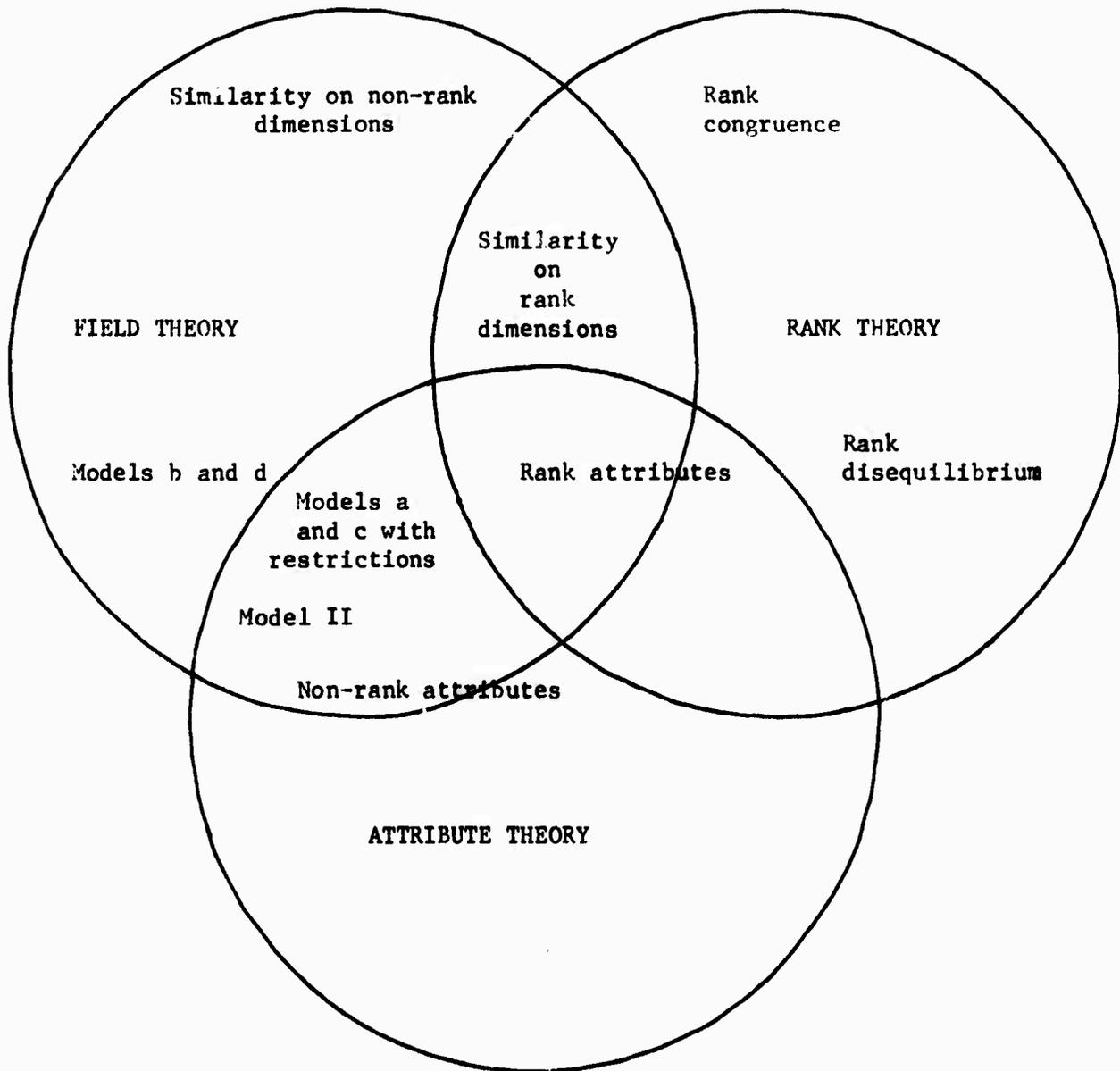
6. A COMPARATIVE TEST

Figure 6.1 gives a rough ordering of the various points of similarity and difference in the three theories.

In short: rank theory and attribute theory have in common the explanation of behavior in terms of attribute magnitude -- but only for rank attributes. Field theory and rank theory have in common the hypotheses that similarity matters -- but again only for rank dimensions. Field theory and attribute theory coincide for models a and c (i.e., field theory is a version of attribute theory, with restrictions on the coefficients, as pointed out above). Models b and d and similarity on non-rank dimensions distinguish field theory from attribute theory and rank theory respectively. Rank congruence and rank disequilibrium are concepts unique to rank theory.

This is only a broad overview, however. There are numerous minor differences, some of which make a comparative test problematic.

Figure 6.1 Rank theory, field theory, and attribute theory: similarities and differences in accounting for behavior



A substantive difference has already been touched upon, namely that while rank theory specifies a positive relationship between similarity and positive interaction, etc., field theory does not specify the direction of the relationships. This does not prevent comparison, but implies that for rank theory the sign of the coefficients is a criterion of fit, in addition to overall correlation.

A more serious problem is that field theory dictates the use of independent dimensions of attributes and behavior, while rank theory only specifies variables. Of a large set of relevant variables, field theorists impose order and simplicity by reduction to a smaller number of hypothetical variables (factors), whereas rank theorists select single variables as indicators of conceptually important "dimensions," build additive indices of several related variables, etc. In part this is simply a "methodological problem," although for field theorists it is more important than that phrase suggests because the method has been defined as part of the theory.³⁴ Here, we shall follow field theory -- for the sake of comparison -- in assuming that the factors are the important dimensions.

A third problem related to the first is that among the independent dimensions of the behavior space there are several which are either extremely hard to interpret meaningfully or, even if they can be identified, do not constitute "interaction" of a type which rank theory claims to account for. This will be clearer after examination of Table 6.1.

Of the twelve dimensions, only five are clearly dimensions of (absolute) interaction. For all others, the highest-loading absolute interaction variable has a variance common with the factor of 50% or lower. These five are two conflict variables: "negative sanctions" and "deterrence," and three dimensions of positive interaction, "salience," "students," and "diplo-

³⁴Rummel holds that factor analysis is more than a method, it is a theory. He draws here on the analogy with quantum theory in physics. See Rummel, 1967c, and Rummel, 1970.

Table 6.1 Dimensions of Dyadic Interaction, with Some High-loading Variables,

1955 Data, Selected Sample

Rank order of factor	Percentage of total variance	Highest-loading variables		Relative interaction variable	Loading
		Factor	Absolute interaction variable		
1		Saliency	No. of translations	Relative translations	.26
2		UN voting 1	NR	NR	-
3		Communications	No. of emigrants	Relative foreign mail	.90
4		Exports	NR	Exports/GNP	.95
5		Students	No. of foreign students	Relative no. of foreign students	.83
6		Diplomatic	Embassies and legations	Relative embassies	.88
7		International organization	International governmental organization memberships	Relative international organization memberships	-.86
8		Negative sanctions	No. of negative sanctions	NR	-
9		Deterrence	Military violence	NR	-
10		UN voting 2	NR	NR	-
11		War opposition	NR	NR	-
12		Migrants	Foreign mail	Relative emigrants	-.88

Source: unpublished materials, DON Project.

Note: NR means not reported

matic." Clearly, salience is the most prominent dimension of absolute, positive interaction. In addition to the very high loading of "translations," we also find "number of treaties," "number of tourists," "exports," and "common international non-governmental memberships" with loadings above .5 on this factor.

We would expect, therefore, that rank theory would relate best to salience, then to the two conflict dimensions and students and diplomatic, and only marginally to the remaining seven dimensions of interaction.

Thus, we see no particular reason to expect a relationship between the rank concepts and "the number of common international non-governmental organization memberships divided by the total of international non-governmental organization memberships of the two countries in the dyad." For the division by this total (this is the general form of the "relative" interaction variables) serves precisely to remove any effect of the total rank of the nation. Even though the resulting ratio may be related to some of the other rank concepts, we are at least deprived of what is probably our most important predictor.

Fourth, there is the problem of interpreting the dimensions. Some of the dimensions have a high, but not an extremely high relationship to the highest-loading variable. In rank theory, only the prediction to the variable is meaningful, and any discrepancy between the actual loading and a perfect loading of 1.0 contributes to washing out the relationship. Thus, even the "diplomatic" dimension with a loading of .83 is somewhat dubious. In the interests of comparability rank theory will be applied to all the dimensions of behavior space, but a separate analysis will also be reported for the most meaningful dimension of positive interaction, namely, salience.

Another important methodological decision related to the use of ranks vs. the original values on the rank dimensions. Although the language of rank theory might suggest ranks, we felt that the potentials for interaction are more likely to be dependent upon the amount of resources available in terms of the rank dimensions. Thus, values rather than ranks will be used here.³⁵

A final procedural question is that of continuous vs. dichotomous parameters. Field theory uses differences (or squared differences) on the raw data (or a linear transformation, such as standard scores). In most work in rank theory, rank variables have usually been dichotomized or trichotomized. There may be some theoretical arguments for this, for instance that social actors themselves do not make as fine distinctions, and that two or three categories correspond more realistically to the image of society held by the actors. However, there are also counter-arguments, such as this: social actors make finer distinctions in the strata immediately surrounding their own rank. Thus, we need all values to capture the full range of discriminations made by all social actors, even if no one social actor keeps all the values distinct. By and large we feel that the emphasis on dichotomization and trichotomization is a methodological precept carried over from the day of the tabulator when it had considerable practical advantages, but no longer so compelling in the age of the computer.

Of the fourteen dimensions of attributes only the first two -- size

³⁵For a brief statement of (but no solution to) this dilemma in stratification theory, see Curtis and Jackson, 1968, p. 115.

Table 6.2 Basic Indicators of Rotated Independent Dimensions of Nations, 1955

Rank order of dimension	Percentage of total variance	Dimension	Basic indicator	Loading
1	20.0	Wealth	Energy consumption/ population	.90
2	11.1	Size	National income	.90
3	9.0	Political orientation	Freedom of group opposition	.71
4	4.6	Foreign conflict behavior	No. of threats	.85
5	4.3	Density	Population/area	.90
6	3.6	Catholic culture	Roman Catholics/ population	-.73
7	3.4	Domestic conflict behavior	No. killed in domestic violence	-.69
8	3.2	Oriental culture	No. of religious groups	.65
9	2.9	Foreign students	Foreign college students/ college students	.73
10.5	2.7	Seaport dependency	Seaborne goods loaded and unloaded/GNP	-.70
10.5	2.7	Equality	Educational expenditure by government/govt.	.62
12	2.4	Traders	Exports/GNP	.70
12	2.4	Diversity	No. of language groups	-.69
12	2.4	Sufficiency	Proteins/calories	.61

Source: This table contains information from Tables 11.1.1 and 12.4.1.1 in Rummel, forthcoming

and wealth -- are clearly rank dimensions.³⁶ The analysis in the following will therefore be limited to these two as far as rank theory is concerned. However, it must be kept in mind that field theory takes distances on all these dimensions as independent variables. The whole set of dimensions is given in Table 6.2.³⁷

An adjustment had to be made in testing field theory. The theory requires factor scores on the fourteen dimensions for the calculation of distances. However, because of missing data in the data matrix for 1955, factor scores were never calculated. Therefore, the present analysis -- like most of Rummel's own -- makes use of "marker variables" or "basic indicators" of these dimensions, that is variables which load highly on the dimension. These variables are also given in Table 6.2.

7. DATA

For practical reasons all empirical tests will be on data collected by the Dimensionality of Nations Project for the year 1955 (or as close as

³⁶Unfortunately, we cannot justify the selection of only the two first dimensions as rank dimensions on other than intuitive grounds. Ideally, the validity of the direction and salience of the rank dimensions should be investigated by having the social actors themselves confirm them. There is, to our knowledge, no systematic comparison for the international system, of "objective rank" on attribute variables such as these two dimensions and the evaluation by actors in the system. However, a few studies have shown a fairly strong relationship between objective rank (operationalized by variables measuring size and wealth) and a subjective rank or prestige measure, using students (Mora and Schwartzman, 1966) or school-children (Shimbori *et al.*, 1963) as judges.

³⁷The names of the first two factors ("size" and "wealth") are from Sawyer, 1967. In other DON Project publications, the labels "power" (or "power potential") and "economic development" are more common.

possible) for attribute data and 1955-57 for the conflict data. The number of nations included is 82, or all independent nations with a population larger than 800,000. For the pairwise analyses information is not available on the complete world matrix. It would have been prohibitive to collect data for all the variables for 82 x 81 nation pairs. Instead, the DON Project adopted the procedure of using two samples of dyads, one random and one selected. The present results are all for the selected sample, i.e. for 182 pairs of fourteen selected nations. Most work performed in the DON Project so far indicates that it makes relatively little difference whether one uses one sample or the other and that, to the extent comparison is possible at this time, most analyses on the samples correspond well with analyses of the complete matrix. However, as a minimum the following analyses should be repeated on the random sample. In any case, the reader should keep in mind that the attribute data used to generate rank parameters and field theory distances in section eight come from a sample of fourteen nations only. (See Rummel, 1969a, p. 46 for a list).

The factor analysis of the attribute space is reported by Sawyer (1967) and in more detail in a forthcoming book by Rummel (forthcoming, a). It yielded fifteen basic dimensions of nations, the first fourteen of which were retained (cfr. Table 6.1).

The quality of the attribute data is, of course, highly varying. The charge that is often leveled at quantitative research: that there is a negative correlation between availability of information and the relevance of the variable is not entirely without substance.³⁸ What little systematic

³⁸See, for example, Stouffer, 1969. Needless to say, to this author the answer would seem to lie in a lot of hard work to provide better data for the interesting questions.

research there is on the subject of error, however (Rummel, forthcoming, b) seems to indicate that there is no particular reason to assume that it has distorted a great deal the findings obtained by the DOM Project. One major reason for this, of course, is the reliance on hypothetical variables (factors) closely associated with a set of variables, rather than single variables which intuitively "seem to be typical" of the dimension they are supposed to tap.

For the positive interaction variables the same point can be made: some information is probably wrong or incomplete, but the overall behavior dimensions are probably not too far off. With the negative interaction variables, however, we have more serious doubts. All these variables have been obtained from content analysis of the New York Times or its index. It would seem extremely likely, then, that there is a bias in the data toward reporting events which are important to the United States and to American readers. Interaction between the U.S. and other countries will probably be over-reported, and also interaction between other NATO countries, or other U.S. allies.³⁹

A second problem consists of relying upon reporting at all, rather than the primary sources or secondary sources specially compiled for data-gathering purposes. Attribute data tend to come from UN documents and related sources. Positive interaction data, whether mail flows, no. of common memberships in international organizations, voting agreement in the United Nations, etc. all come from statistics compiled by record-keeping

³⁹There is some research (cfr. McCormick, 1969, pp. 49ff and references) which indicates that the New York Times gives a good overall picture. However, the hypothesis mentioned has not been systematically tested.

organizations. Until recently, however, there has been no book-keeping agency for international conflict behavior.⁴⁰

In short, whatever the results we will have to exercise more caution with regard to the findings on conflict behavior.

8. A DYADIC TEST OF THE THREE THEORIES

To relate a set of attribute functions to a set of behaviors we need a method which will permit an extension of the usual concept of the one dependent variable to a set of dependent variables. Within the framework (and the limitations!) of the linear model and least squares estimation, canonical regression analysis is the appropriate model for this purpose. Just as ordinary multiple regression analysis tells us how much of the variation in one dependent variable can be accounted for by the variation in the set of independent variables, canonical analysis tells us -- among other things -- how much of the variation we can account for in a set of dependent variables.⁴¹

Table 8.1 gives an overview of the results for field theory, rank theory, and attribute theory. The correlations reported are "trace correlations," the technical formula for which is $\sqrt{\frac{\sum_{k=1}^r r_k^2}{r}}$ where r_k is the

⁴⁰The best effort so far is probably the handbook edited by J. David Singer et al. (forthcoming). See also the SIPRI Yearbook (1969) for post-war data. Even so, these sources of information are restricted to the more drastic forms of conflict behavior.

⁴¹For a discussion of canonical analysis, see Cooley and Lohnes (1962). For an application to international relations with a discussion of the model, see Phillips and Hall (1969).

correlation for the k-th combination of combinations of variables from the right and left side of the equation and g the number of dimensions. In a rough sense a trace correlation can be thought of as an average multiple correlation for each of the behavior dimensions when predicting from all of the attribute dimensions.

The results are not strikingly different. In terms of the overall relationship, field theory does somewhat better than rank theory and a little poorer than attribute theory (although after eliminating the six last dimensions because of near-singularity we obtained results for attribute theory close to those of field theory⁴²). With geographical distance included, the results are again relatively similar, although this has not been computed for attribute theory. It should be noted here that rank theory improves more than field theory when geographical distance is introduced; this is partly because we have introduced interaction terms between rank and distance in the regression equation. Previous work has indicated that the relationship between total rank and interaction and geographical

⁴²To say that the matrix of variables on one or the other side of the equation is singular means that one variable is a linear function of one or several of the other variables in the matrix. In econometrics, this is usually called the problem of multi-collinearity or correlated independent variables. For a brief introduction with sociological examples, see Blalock, 1963. Many statistics books warn against using correlated independent variables, because this creates highly uncertain estimates of the regression coefficients as well as multiple and partial correlations. How uncertain is a question of sample size. Since the number of cases here is 182 and the number of independent variables up to twenty-four, the problem of singularity arises frequently in many of these runs. A handy measure of how close one is to singularity is the determinant of the matrix, which is reported by the computer programs used here. If the determinant is extremely low, one is close to singularity, and the only way out is to exclude one or more of the independent variables. In the results reported here, the rank and attribute results are usually somewhat further removed from singularity than the field theory runs, except where "suspicious results" are explicitly reported.

Table 8.1 An Overall Comparison of Rank Theory,
Field Theory, and Attribute Theory (Trace
Correlations)

	Rank theory	Field theory	Attribute theory
geographical distance, not included	.34	.48 (.51) ⁺	.53 (.61) ⁺⁺
geographical distance included	.42 (.50) ⁺⁺	.51	NC

+ Model b (model c)

++ Results suspicious because of near singularity of the matrix. The non-suspicious but somewhat lower correlation for rank theory was obtained by deleting all interaction terms between the rank parameters and geographical distance, except for total rank. In the case of attribute theory the six last dimensions were eliminated in order to avoid singularity.

NC - not computed

distance and interaction is interactive (Linneman, 1967; Gleditsch, forthcoming). This was taken care of by introducing total rank divided by geographical distance as a separate variable. Similar interaction terms were also introduced between the other rank concepts and distance, but although they added a little to the overall relationship (trace correlation up from .42 to .50) they also introduced near-singularity of the attribute matrix and the results must therefore be regarded with suspicion.

The next table, Table 8.2, gives a comparison for the three first models of field theory, with and without geographical distance. Geographical distance makes relatively little difference in all of them, indicating (once again) that a linear function of the distance variable does not predict

well to international behavior. Furthermore, model b using squared distances does better than model a which predicts from distances, but the "sum" model, model c, does better than any of them. This is a little unexpected. Models b and c are both symmetric models and interaction, as we have noted, is asymmetric although a strong trend towards symmetry may be assumed. Apparently, the assumption of the first model of "opposite" behavior in the A to B dyad and the B to A dyad, is much more unrealistic. Best of all, it appears, is the asymmetric model which does not make any assumption about opposite behaviors and this is, of course, the attribute model.

Table 8.2 Models of field theory (trace correlations.)

Model using		a d	b d ²	c s	d s ²
Geographical distance	not included	.30	.48	.51 (.53)	NC
	included	.36	.51	.55	NC

NC = not computed

All in all, then, it would seem that there is not much evidence to discriminate the three theories in terms of the overall relationship between attributes to behavior, although rank theory appears to lag a little behind the others. With regard to field theory specifically, there is absolutely no evidence that the two "distance" models account better for this set of behaviors than the alternative "sum" model (model 3).

We may analyze this a little more closely by taking a look at the particular linkages between attributes and behavior found by the canonical analyses. Tables 8.3, 8.4, and 8.5 set out the main relationship for each of those theories.

For rank theory we find the expected relationship between total rank and salience first, with a canonical correlation of almost .9. (This first equation also links salience positively to profile dissimilarity, contrary to expectation.)

Third, two measures of geographical distance are related to voting dissimilarity on East-West issues in the UN General Assembly.⁴³

The fourth equation does not link any one variable on one side very clearly to one on the other, but the fifth links disequilibrium and incongruence on the one hand to war opposition (negatively) and deterrence (positively). In other words, the joint disequilibrium of the two nations is positively associated with conflict behavior in the pair (as hypothesized) but negatively with the history of war between the two. It might be interesting to speculate on what this means, but the relationships are relatively weak.

On the whole, the specific results are consistent with rank theory, with one major exception: we find rank profile dissimilarity rather than similarity related to positive interaction. This comes out in equation one in Table 8.3, and is reinforced by looking at the bivariate correlations of rank profile similarity with salience, $-.40$; with exports, $-.27$; with diplomatic interaction, $-.14$. Why is this so? The explanation is simply

⁴³The two issue dimensions in UN voting used here are taken from a yet unpublished DON Project factor analysis of UN voting. These two dimensions are similar to the first two dimensions of the previous analyses of UN voting by Alker and Russett (1965), although there are a number of differences in coding and design of the study. The names used by Alker and Russett (East-West, North-South) have therefore been used here. The North-South factor is sometimes called Self-Determination voting in DON publications.

Table 8.3 Linking Behavior to Attributes: rank theory
(All variables entering with canonical variates > .5)

Equation	Attributes	Canonical Correlation	Behavior
1	+Total rank Profile dissimilarity	.80	Saliency
2	+Total rank/distance	.65	Negative sanctions Deterrence
3	+Inter-capital distance +Inter-territory distance	.60	+Voting dissimilarity on East-West dimension
4	(Profile dissimilarity)	.49	-(Foreign students) (Voting dissimilarity on North-South dimension)
5	+Rank disequilibrium Rank incongruence	.45	-War opposition (Deterrence)

+ = Canonical variate .7.

() = no canonical variate > .5, but the highest variable(s) given.

- = sign reversed; e.g. a high value on the "foreign students" variable means a low number of foreign students.

that the two rank variables (size and wealth) are so skewed that the difference between two nations is highly correlated with the sum.⁴⁴ Thus, "rank profile dissimilarity" comes to be correlated an incredible .94 with "total rank" for this set of data. This problem comes up again and again with the present data.

⁴⁴To clarify: if one nation is "way out" on a value much larger than that of all other nations (as the US is on both National income and Energy consumption per capita) then its value(s) will make the major contribution when the values are summed. However, it will also make the major contribution to differences or squared differences. Therefore, this one extreme nation alone may cause a high correlation between the sums and the squared distances. When--as in this sample--the US is one of 14 nations rather than one of 110 or 220, this problem is exacerbated.

One disappointing aspect of this test of rank theory is that the rank concepts other than total rank do not appear to provide any strong relationships with any of the behaviors. (Disequilibrium does come in, but not very strongly.) In part this seems to be due to the peculiar distribution of the variables used as indicators of the rank dimensions.

For field theory the individual equations are harder to interpret meaningfully. Perhaps the most meaningful is number three which relates similarity in national income to similarity in North-South voting in the UN. "North-South" is one way of summing up the major "class division" in the international community, and it makes intuitive sense that voting on a corresponding issue dimension should be related.

Single behavior dimensions do not stand out clearly as being related to squared distances. The equations relate linear combinations of behavior dimensions to attribute distances but there are few high loadings. There is no reason, of course, within field theory to expect strong relationships, since the theory only makes a statement about the relationship between the two spaces as a whole.

Table 8.5 relating attributes directly to behavior gives some more interesting relationships, however. In equation 2 we find the relationship between total rank and interaction again, although total rank has been split up in its two components of size and wealth here. The first equation, however, relates political orientation or, more specifically, "freedom of opposition groups" to "international organization participation." In other words, the more freedom of opposition within the country that country x is interacting with, the larger the interaction (i.e. the number of common memberships) is for x. Or, more specifically still, countries with high internal political freedom

are more important interaction partners for other nations generally in international organizations. This is not surprising in view of the common observations that countries with low internal freedom also exercise control over and limit participation in international organizations. Not surprisingly, international governmental organization memberships and non-governmental organization memberships both load about .5 on the political orientation dimension in the by-nation factor analysis.⁴⁵

The other equations are less clear. In equation 3, for instance, we find that the two rank attributes of the receiver are related positively to one and negatively to one form of foreign conflict behavior.

By and large, then, it seems that the three theories play variations on the same (rather trivial) theme: that absolute, positive interaction can -- to a large extent -- be predicted from the magnitude of rank attributes. The other attribute dimensions are somewhat less important, it seems, than the first two dimensions of size and wealth, and these two are precisely the ones we have identified as the rank dimensions. The trace correlation between attributes and behavior increases from .35 to .48 when the next four dimensions are added to the two first, and to .52 when another two are added. (As noted, we cannot include all fourteen dimensions, since this introduces singularity in the matrix.)

Furthermore, as far as the two rank attributes are concerned, the attributes of sender and receiver enter into the equations quite symmetrically. Thus, for the two dimensions of size and wealth, there is relatively little to

⁴⁵Loadings of .46 and .52 respectively on the obliquely rotated factors.

Table 8.4 Linking Behavior to Attributes:
 Field Theory, Model 2

Equation	Attribute	Canonical Correlation	Behavior
1	Similarity in freedom of opposition Dissimilarity in no. of languages	.76	War opposition
2	Similarity in freedom of opposition Dissimilarity in educational spending	.74	-(War opposition)
3	Dissimilarity in national income	.70	Dissimilarity in voting on North-South dimension
4	Dissimilarity in national income Similarity in no. of religions	.66	(Salience)
5	Dissimilarity in domestic conflict	.67	-(Communications)
6	Dissimilarity in density Dissimilarity in trade dependency	.45	-(Foreign students)

() : see note to Table 8.3.

gain by the distinction between sender and receiver in predicting to the behavior variables included here.

The fact that the sum model of field theory does better than the difference or squared differences models again indicates that attributes (and not primarily attribute differences) are important, and that they enter symmetrically.

Then, rank theory does almost as well as field theory and attribute theory in spite of the fact that the rank concepts other than total rank do not yield very much, and in spite of the fact that rank theory in its present version does not make any use of the information in the twelve other attribute dimensions in predicting to behavior. This again confirms the central place of the two rank attributes. It indicates also that we lose relatively little in this case by using the more general concept of rank, rather than the more specific concepts of size and wealth in accounting for interaction. But this was a priori obvious since the two were correlated by nation (about .6) and even more highly over the pairs (above .8).⁴⁶

In other words, then, we end up with some support for all the three theories, but for all of them it's can largely be traced to the correlation of the two rank dimensions with interaction.⁴⁷ To choose between the three

⁴⁶The marker variables of the two dimensions are correlated .6, in spite of the fact that the dimensions are not. If Population had been chosen instead of National Income as the marker variable for size, the two marker variables would have been uncorrelated.

⁴⁷As indicated above, the skewed distribution on the two rank dimensions makes the sums of rank scores for a pair highly correlated with the differences in rank scores. If the distributions were less skewed so that this problem didn't arise, we could control for one while correlating behavior and which model of field theory does best. As it is, the evidence is marginal, but leans in the direction of the sum model or attribute theory over the distance models of field theory.

Table 8.5 Linking Behavior to Attributes: Attribute Theory

Equation	Attributes	Correlation	Behavior
1	Political orientation of receiver ^{**}	.51	*International organization
2	Wealth of sender Wealth of receiver Size of sender Size of receiver	.84	Saliency
3	*Size of receiver Wealth of receiver	.77	-(Deterrence) -(Saliency) (Negative Sanctions) (Exports)
4	Catholic culture, sender -Size of sender Catholic culture, receiver	.68	-(War opposition)
5	Domestic conflict of sender	.47	- Communications)
6	-(Density of sender)	.45	Migrants

^{*}, - () : see note to Table 8.3.

^{**}A high loading in this factor means a democratic political orientation.

theories, then, becomes a matter of theoretical preference, since all three seem to do equally well or equally poorly in accounting for international behavior in the mid-fifties.⁴⁸

Rank theory does a little worse as a predictor to the whole behavior space (a role, as we have pointed out repeatedly, rank theory was not in any case designed to perform).

On the other hand, rank theory does better than field theory when it comes to accounting for absolute positive interaction, as measured by the salience dimension. A multiple regression analysis indicated a multiple correlation coefficient of .62 for rank theory to salience whereas field theory gave .48. However, the higher correlation of rank theory was, again, mainly due to the single correlation between total rank and salience (.55), and is therefore just as consistent with attribute theory.

The only deviation from this general picture is the first equation found for attribute theory, which linked political orientation asymmetrically to international organization participation. While this was not specifically hypothesized in advance it is certainly an example of a reasonable "attribute hypothesis."

Finally, it should be noted that the overall relationship between attributes and behavior is not very strong, whatever the theory. The best we have been able to do is .50 - .55, or 25 - 30% of the variance. Moreover, since canonical and trace correlations vary only between 0 and 1 (not -1 and 1) 0 does not represent the random level. A canonical run of five random

⁴⁸The distance model (model a) definitely does worse, however.

variables against five random variables gave a trace correlation of .21. The correlation of rank parameters generated from two random rank dimensions and including geographical distance, came out as .39! (doubtless, this last result is again suspicious because of near-singularity.) This in itself should be cause for further theoretical reflection and refinement of the data.

However, with regard to salience, rank theory produces an r of .62, corresponding to 38% of the variance. Here it should be kept in mind that salience is the dimension which accounts for the most variance in the dyadic behavior factor analysis (11.3% of total variance, versus from 11.2% to 4.3% for the other eleven factors). This consideration improves the performance of rank theory relative to field theory, since rank theory does better with regard to the major interaction dimension.⁶³ It is important to keep in mind, though, that for field theory the idea of matching two spaces is theoretically important, regardless of the share of the variance of the different behavior dimensions. For rank theory, it is more pertinent whether the hypotheses are consistent with more variation in overall interaction.

9. RANK AND FOREIGN CONFLICT: A BY NATION ANALYSIS

The preceding section indicated something about the overall relationship between attributes and attributes functions and interaction of the pair. In addition, we suggested a few specific relationships, mainly between

⁶³However, we do not know, of course, whether the variables included in this factor analysis formed a representative sample of all interaction variables or, indeed, whether "the universe of interaction variables" is a meaningful concept. A point which it is particularly important to keep in mind here is that book-keeping and data-collection in international relations so far has been biased in favor of symmetrical forms of interaction, thus to some extent imposing symmetry upon the analysis.

positive interaction (salience) and total rank. There is no single dimension, however, which can equally clearly be interpreted as the dimension of absolute negative interaction or conflict behavior, but a significant relationship was found between total rank/geographical distance and two conflict dimensions. The purpose of this section will be to explore the relationship between rank and conflict a little further. And since both of our two hypotheses were primarily at the nation level, we shall perform the analysis by nation rather than by dyad.

Table 9.1 presents the major results for foreign conflict. It involves several methodological decisions, which must be justified briefly.

First, over- and under-achievement were defined in multiplicative terms, rather than in additive. This serves two purposes. It "solves" the identification problem in the sense that both interaction effects can be identified independently of the main effects. But it also has theoretical meaning in the sense that these terms define relative over- or under-achievement from a baseline. In other words, we define:

	under-achievement	as	$\frac{\text{ascribed rank}}{\text{achieved rank}}$
and	over-achievement	as	$\frac{\text{achieved rank}}{\text{ascribed rank}}$

In the first case, an achieved status is the baseline and under-achievement is measured as the relative deviation of ascribed from achieved rank. In the second case, the ascribed status is the baseline, and the deviation of the achieved rank is taken to measure over-achievement. The labeling of terms is not quite adequate. The first term might more adequately be called over-ascription, whereas under-achievement would consist of a low over-achievement.

Table 9.1. Rank and Foreign Conflict Behavior, 1955-57

Variable	Correlation with conflict	Multiple correlation	Direction of relationship ⁺)
Size (s)	.533	.533	+
Rank product (s*w)	.479	.588	-
Under-achievement (s/w)	.047	.607	-
Wealth (w)	.299	.617	-
Over-achievement (w/s)	-.115	.622	+
Domestic conflict	-.050	.623	-

n = 82

⁺) The sign of the regression coefficient is the direction of the relationship. Note that this need not be the same as the sign of the bivariate correlation. Partial correlations for the final regression are not reported by this computer program, but the variables are listed in the order of decreasing contribution to the multiple correlation.

Similarly, under-ascription would be the reverse of over-ascription, and different from over-achievement. In other words, one is measuring the relative deprivation or "rewardedness," rather than the absolute. It is a nice theoretical thought that we might postulate that "nations will always measure their relative deprivation according to their highest rank." This would imply, then, that nations would always be either under-achievers or under-ascribers (and, simultaneously, always negative over-ascribers or negative over-achievers). However, we shall let the idea rest.

Secondly, the decision was made to incorporate a multiplicative interaction term: size x wealth. This measure has sometimes been advocated

as an index of power and was included in the 197 236 variable factor analysis. In the present context its interpretation would be the following: with a negative sign -- decreasing marginal returns in terms of the conflict behavior of a generalized topdog; positive sign - increasing marginal returns, or "economies of scale" of being a generalized topdog in terms of generating conflict behavior.

As Table 9.1 shows, for marker variables for 1955 at least, size is still the best predictor to foreign conflict behavior. Next follows the rank product, with a negative sign, then under-achievement and wealth, also with negative signs, then over-achievement with positive sign and domestic conflict with a negative sign. All of the predicted relationships are in the right direction, but most of them (that with size being the only exception) are small. Even so, we are able to predict just as well to this conflict variable as we were to the salience dimension, i.e. to positive interaction. The major difference between the two is that size alone is more important here and that the interaction terms are more important than the wealth dimension.

It is interesting to note that $-s/w$ is more important in accounting for foreign conflict behavior in 1955 than w/s . In other words, it is "under-achievement" rather than "over-achievement" that seems to have some relationship to foreign conflict behavior here, although for both the increment in the multiple correlation coefficient is low.

The negative sign for $s \times w$ and the fact that this turns out to be the second most important variable indicates that it is not necessarily the topdog-topdog countries which have the most foreign conflict, but some of the "upper middledog" powers, with a relative decrease towards the very top. It is also interesting that wealth in itself is negatively related to foreign

conflict once size has been taken into account. This is contrary to the general expectation of a positive relationship between rank and foreign conflict behavior.

(Table 9.1 indicates, also, that the second-order factor of rank disequilibrium (high wealth, low size, and high foreign conflict) found by Rummel probably did locate an interaction effect, rather than a constellation of main effects since the main effects are exactly opposite.)

A problem with this analysis is that the foreign conflict variable for 1955-57 has three large outliers: Israel, UK and the USSR. The first of these two fought a war in the period, while the USSR conducted an invasion. (So did France and UK, but they are not as extreme outliers in the data.) If we eliminate these three countries, the correlation between size and foreign conflict behavior increases to about .3 -- in other words, as high as for positive interaction either by nation or by pair. Examination of the scatter diagram indicates that the US is an extreme outlier in this case, and is largely the cause of this high correlation. But if we accept a higher correlation, at any rate, when the three nations which were at war in the period are excluded, we might conclude that we can account quite well for conflict behavior by total rank (mainly by size alone) and interaction between the rank variables, as long as we limit the conflict behavior to the levels below war. In order to explain war, and the much larger amounts of conflict behavior associated with it, we would have to introduce other explanations, e.g. in terms of accumulated tensions over a long period of time.

Additional analysis using absolute definitions of rank disequilibrium (absolute differences between ranks, rather than ratios) generally support

these conclusions. However, there is a limit to how many attractive models we can try out on these data, with their peculiarly skewed distributions, relatively scarce conflict behaviors, and the problems of incompleteness of the data. We would not place too much trust in these findings. However, within the limitations of the data, rank theory does appear to receive considerable support.

The question of domestic conflict is on the periphery of our concerns here, since it is not a form of international interaction at all. However, it is interesting to note that when subjected to a similar analysis, the interaction term of under-achievement (s/w) again comes out to be the most important predictor. However, the correlation is a mere .16. Transformations which pull in the outliers increase this correlation, but we have not attempted to set up a model which can justify such transformation.

We conclude then, that total rank is relevant to negative behavior of a nation, as well as to positive behavior, although the size component of rank seems to be the only important one in the case of foreign conflict. The disequilibrium hypotheses receive some support, both for foreign and domestic conflict, but for foreign conflict the effect is dwarfed by the effect of size.

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13. ABSTRACT Introduction

Of the many explanations which have been invoked to account for behavior in the international system, rank theory and field theory are two of the most systematic approaches. They also claim greater relevance and applicability than most hypotheses about the international system. There are many contextual similarities: both grew out of dissatisfaction with the paucity of theory in international relations as of the early nineteen-sixties; both draw on traditions in previous writings in sociology and political science, while formulating several hypotheses much more precisely or with clearer relevance to international behavior; neither theory has been expounded at great length in textbook presentations but have to be sought out in scattered journal articles. Finally, both represent something more than a theory: they spearhead research traditions, even movements perhaps, that will be with us for some time. For all these reasons, it is tempting to undertake a comparison of the two, and to apply them to some empirical data about international relations in the post-war period.

Attribute theory, on the other hand, as will be evident from the following, has not been seriously proposed as a theory at all, but serves mainly a contrasting function.

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KEY WORDS

LINK A

LINK B

LINK C

ROLE

WT

ROLE

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ROLE

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international behavior