Structural Equivalence and International Conflict, 1816-2000: A Social Networks Analysis of Affinities and Conflict

Zeev Maoz
Department of Political Science
University of California, Davis
Davis, CA 95616
zmaoz@ucdavis.edu

Ranan D. Kuperman
Department of Political Science
University of Haifa
Haifa 31905
Israel
ranank@poli.haifa.ac.il

Lesley Terris
Department of Political Science
Tel-Aviv University
Tel Aviv 69978
Israel
lesley@post.tau.ac.il

Ilan Talmud
Department of Sociology
University of Haifa
Haifa 31905
Israel
talmud@soc.haifa.ac.il

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Abstract

The concept of international affinity—albeit under different names—captures a central place in international relations research. This study examines how different types of affinity affect the likelihood of conflict between states. We discuss notions of affinities derived from the realist, liberal, and culturalist paradigm and derive hypotheses regarding the impact of different types of affinity on the probability of dyadic conflict. We point out some of the weaknesses in existing measures of structural affinity. We offer a social networks conception of structural affinity—the concept of structural equivalence—which reflects the similarity of international ties across a set of different networks. A test of the hypotheses derived from these paradigms using both existing measures of affinity and our own structural equivalence measures suggests several findings: (1) strategic affinity has a consistent dampening effect on the probability of dyadic conflict; (2) trade-related affinity does not have a significant impact on the probability of dyadic conflict; (3) IGO-related affinity has a negative impact on conflict, mostly in the 20th century. (4) Cultural (linguistic and religious) affinity also does not appear to have a significant or consistent effect on the probability of dyadic conflict. We discuss the implications of our findings for theories of international politics.
1. Introduction

Underlying many of the studies on international conflict are different notions about the impact of different affinity-related factors on dyadic conflict. Quite a few determinants of international conflict—alliances, regimes, trade interdependence, and joint IGO membership—reflect latent notions of affinity. For example, alliances are seen to reflect common security-related interests (Gowa, 1999; Farber and Gowa, 1997). Trade is seen to reflect economic interdependence. Joint IGO membership is seen to reflect common visions about collective management of international politics (Keohane and Martin, 1995; Russett and Oneal, 2001). An alternative interpretation of affinity focuses on common traits linking actors together, such as cultural similarities (e.g., Huntington, 1996; Henderson, 1998; Henderson and Tucker, 2001; Russett, Oneal, and Cox, 2000; Henderson, 2004) or socio-economic (class) status (Galtung, 1971; Korany, 1984).

Affinity-related factors lie at the heart of several deductive theories of international conflict (Bueno de Mesquita, 1981; Bueno de Mesquita and Lalman, 1992), and their empirical implications (e.g., Bennett and Stam, 2000b, 2000c, 2004). These suggest that affinity is taken to represent what rational choice theorists call “revealed preferences.” In other words, some dyadic affinities represent the result of—presumably rational—choices of states. Alliances represent decisions of member states to pool resources for the purpose of common security. Similarly, the set of trading partners of a state also reflects revealed economic preferences (one state is willing to export what another needs to import, and at prices that are economically profitable for both).

Other kinds of affinities that cannot be readily interpreted as revealed preferences may also constrain choice. For example, the democratic peace literature—especially in its normative incarnation (e.g., Doyle, 1986; Maoz and Russet, 1993; Dixon, 1994)—asserts that common norms determine states’ behavior in conflict situations.
The concept of affinity is widely used in different disciplines such as cultural anthropology, sociology, social psychology, and organizational behavior (e.g., Swift, 1999; Bowles and Gintis, 2004). Two definitions characterize the literature. One views affinity as a perception of belonging to, “liking” of, or identification with a given group, organization, culture, or political movement (Swift, 1999: 184; Gaffie, Marchand, and Cassagne, 1997: 180). The other views affinity as the degree of similarity among a set of units on a number of traits. This similarity or closeness may entail subjective perceptions or it can be based on observable attributes (Bowles and Gintis, 2004).

It is important, however, to distinguish between what we call *structural affinity* and straightforward *similarity*. *Similarity* taps the extent to which two actors share traits or perceive each other to be “like myself;” these are based on the mutual perceptions or common traits of the actors, *independently of other actors in the system*. On the other hand, we suggest that *structural affinity* reflects the extent to which actors are similar to each other in terms of *their relations with other actors*, or in terms of the similarity of their traits, *in relation to other actors’ traits*. Clearly, two actors that are (or perceive themselves to be) similar to each other would naturally feel that they have a similar relations with other actors. The converse is not true, however. Two actors may feel that they are different from one another, but their differences are minor compared to their differences compared to other actors in the system. We elaborate on these differences below.

We define structural affinity as a *behavioral or attributional similarity between states*, based on the direct and indirect relations between them (or their common attributes) and on the similarity of the patterns of ties (or attributes) each of these states has with other members of the interstate system.

In this study, we discuss different types of affinity-related conceptions in the realist, liberal, and culturalist paradigms. We explore the following issues:

1. How do these paradigms address the relationships between different types of affinity and dyadic conflict?
2. How does the social network concept of structural affinity relate to existing conceptions and measures of affinity?

3. How does an integrative multi-dimensional conception of structural affinity that integrates these paradigms affect the probability of dyadic conflict, and how is the impact of the integrative measure on dyadic conflict similar or different from the impact of its components?

Our approach to the study of international affinity is based on social network analysis, an approach that was widely used in epidemiology, sociology, social psychology, economics, and organizational behavior (Wasserman and Faust, 1997: 3-27; Watts, 2003: 47-55), and even in American and comparative Politics (e.g., Huckfeldt, Johnson, and Sprague, 2004; Knoke, 1994; Knoke et al., 1996). This approach offers a framework for the systematic study of relationships among individuals, groups, organizations, and states that is eminently suitable to international relations. Unfortunately, with few exceptions in the late 1960s (e.g., Brams, 1966, 1969), little systematic research has employed this approach to study international relations (Hoff and Ward, 2004: 161; XXXX, 2005: 35-37). We demonstrate—through the concept of structural equivalence—how social networks analysis can illuminate important aspects of the relationship between different types of international affinity and dyadic conflict behavior.¹

2. Structural Affinity and Paradigms of World Politics

The key divide in theories of international politics is still between the realist and liberal perspectives (e.g., Waltz, 1979; Keohane and Nye, 1977; Keohane and Martin, 1995; Russett and Oneal, 2001). In recent years cultural approaches (Katzenstein, 1996) joined the paradigmatic debate, focusing on factors—such as subjective or inter-subjective affinities and culture-based relations (Jepperson, Wendt, and Katzenstein, 1996; Huntington, 1996)—that have not been central in the other approaches.

¹ A more elaborate discussion on how social network analysis can be applied to international relations problems is provided in XXXX (2005) and Hoff and Ward (2004).
All three perspectives envision a negative linkage between dyadic affinity and conflict. They differ, however, in terms of the kind of factors that define this linkage. These differences stem directly from their (informally) axiomatic foundations. Each paradigm emphasizes a different dimension of affinity that is said to dampen the probability of dyadic conflict. In addition, each paradigm either dismisses or downgrades the impact of affinity-related factors that are not part of its world view.

I. Realism

Realists argue that states avoid cooperation due to fear of cheating and due to relative gains calculations (Mearsheimer, 1995). When they do cooperate, however, is when they must: that is, when they face common enemies and/or threats (Mearsheimer, 1995: 12-13; Walt, 1987). Strategic interests of states are difficult to identify empirically. One way of gleaning interests is through the concept of “revealed preferences,” which assumes that rational behavior reveals the kind of preferences that induced it (Morrow, 1997). Building on this notion of revealed preferences, realists see alliance ties as a key indicator of shared strategic interests. The similarity of alliance commitments of two states reflects not only whether they have direct ties which reflect their common interests. It also reflects the extent to which they have common perceptions of threats and opportunities, of friends and foes (Bueno de Mesquita, 1981; Mearsheimer, 1994/1995: 13; Farber and Gowa, 1997; Gowa, 1999). Thus, the prediction of the realist paradigm is:

Realist Hypothesis 1: The greater the degree of strategic affinity between states—defined in terms of common interests and measured in terms of the pattern of their alliance commitments—the lower the likelihood of conflict between them.

The realist perspective also posits that affinities that arise out of institutional arrangements other than security alliances or out of trade simply reflect “the distribution of power in the world” (Mearsheimer, 1994/95: 13). Accordingly:
Realist Hypothesis 2: Affinities that do not reflect security-related interests of states do not affect the probability of dyadic conflict.

II. Liberalism

Liberal theorists readily admit that strategic affinities reduce the likelihood of dyadic conflict. Yet, they argue that strategic affinity is only one factor that affects dyadic relations. Economic and institutional affinities are also important determinants of dyadic conflict. Trade-related affinity reflects subscription to an international economic regime. Joint IGO membership reflects a normative commitment to an institutional management of international politics, rather than to a self-help anarchical structure (Keohane and Martin, 1995; Russett and Oneal, 2001).

The liberal paradigm reasons that institutions have two types of effects on state behavior. First, they provide information that reduces suspicions of cheating, thereby creating long-term benefits which states cannot secure by unilateral action. This long term incentive may offset short-term incentives to compete (Keohane and Martin, 1995; Axelrod and Keohane, 1986). Second, institutions induce norms (e.g., reciprocity) that states find costly to violate (Keohane and Martin, 1995: 45-46). The cost of cutting ties, once established, facilitates long-term cooperation (Crescenzi, 2003).

Accordingly, liberals suggest that economic affinity is more transparent, and therefore less likely to induce fear of cheating. Economic affinity also reflects mutual gains, thus diminishing the competitive impact of relative gains on cooperation. Institutional affinity implies adherence to common norms reflected by the missions of the organizations to which states belong. The liberal paradigm therefore suggests that:

Liberal Hypothesis 1: Trade-related affinity and IGO-related affinity reflect states’ subscription to similar or different international regimes. The greater the degree of trade-related and IGO-related affinity between states, the lower the likelihood of conflict between them.
However, the concept of structural affinity, as we envision here, may also be interpreted by liberal scholars in a different manner. Specifically, two states that have similar trading ties with third parties may actually compete over the same markets (Burt and Talmud, 1993). This competition may be a source of conflict. Thus,

*Liberal Hypothesis 2:* Trade-related affinity reflect states’ competitive environment.

Thus, the greater the degree of trade-related affinity between states, the higher the likelihood of conflict between them.

**III. Culturalism**

Culturalist approaches view international divides in terms of perceived identities. National identities are often defined in cultural—ethnic, linguistic, and religious—terms. Friends and foes are perceived in terms of cultural affinities. Identity-based affinities are basic and fundamental, thus overriding short-term security or economic interests. The clashes are between cultural and civilizational divides marked by linguistic and religious differences, and not within them (Huntington, 1996; Henderson, 1998; 2004). Thus,

*Culturalist Hypothesis:* The greater the degree of cultural affinity between two states, the lower the likelihood of conflict between them.

While these hypotheses do some injustice to complex and multilayered paradigms, this discussion provides us with a theoretical foundation for dealing with a new and broader conception of international affinity than the ones that pervade the literature.

**IV. A Combined Perspective of International Affinity**

These hypotheses are often treated as competing, almost mutually exclusive views of the effects of different types of affinity on conflict. Yet these conceptions may,
in fact, complement each other. International affinity is a multilayered concept that encompasses multiple dimensions of dyadic relations. Strategic and economic factors may have a compound impact on dyadic conflict. First, compound structural affinity incorporates identities, institutional, and interest-related factors. States may perceive affinity as the degree of common traits or interests over a wide set of relationships or attributes.

Second, the behavioral consequences of affinity may be more complex than those posited by each of the paradigms. A high degree of affinity on one relationship may offset the effects of a different type of affinity. For example, economic interdependence may offset difference in alliance portfolios as a determinant of the probability of conflict. Compound affinity based on a wide array of relationships or identities may have a different impact on dyadic conflict than any of its individual components. Thus, integrative affinity may have a negative impact on conflict while some of its components (e.g., alliance-based affinity or trade-based affinity) may have positive effect on conflict. The following integrative hypothesis relates dyadic affinity to conflict:

*Integrative Hypothesis:* The higher the integrated degree of affinity between two states across strategic interests, economic ties, shared IGO memberships, and religious and linguistic similarity, the less likely they are to fight each other.

Since integrative conceptions of affinities have not been explored in the literature, the current study is the first to offer an analysis of compound notions of affinity—based on a number of different relations and attributes—and its effect on dyadic conflict.

**3. Structural Equivalence as a Measure of Affinity**

The concept of structural affinity was converted into an empirical measure for the first time by Bueno de Mesquita (BdM) (1981) via the similarity of alliance portfolios. Alliance portfolios are seen to reveal the extent to which the strategic interests of two states converge. Farber and Gowa’s (1994, 1997) attempt to debunk the democratic
peace proposition is based on the idea that common interests reduce the probability of dyadic conflict.

BdM’s empirical measure of strategic affinity is based on a relationship between the alliance portfolios of any two states. It is measured as the Tau-b association of the alliance portfolios of dyads with other members of the international system. Similar alliance portfolios indicate high affinity (or convergent interests), and negative values indicate conflicting interests. Two nonaligned states typically receive the score of zero, which is the midpoint of the Tau-b scale (-1 to +1).

Signorino and Ritter (S-R) (1999) argue that the Tau-b score suffers from a number of problems. They offer another measure, based on the Euclidean distance between states’ relationships on some property, which—according to them—seems to overcome the anomalies of the Tau-b score. We discuss some of the properties and limitations of these two measures of affinity.

One problem with the Tau-b measure arises from the fact that affinity may vary depending on the type of relationship in question. Different types of relations might yield different affinity measures. The Tau-b score does not allow integration of different relationship types into a single measure (Signorino and Ritter, 1999: 125).

In addition, the Tau-b scheme requires count data such that they can be placed in this kind of $k \times k$ table to develop an ordinal measure of association. This scheme does not apply to cardinal quantities, such as amounts of trade between states.

The S-R measure overcomes these problems as well as additional statistical anomalies (Signorino and Ritter, 1999: 121-123), but it is limited with respect to three additional issues. First, both measures require relational indicators of affinity. Alliances, trade, diplomatic relations, or even conflict can all be used for the Tau-b and S-R measures of affinity. However, affinities based on affiliations such as membership in international organizations or ethnic similarities do not fit into these measurement
schemes. A mechanism for converting affiliation-based data into relational data is required before such measurement schemes can be applied.

Second, both the Tau-\(b\) and S-R scores are based on first-order relations. They do not take account of affinities (or common interests) formed by indirect relations. For example, two states may have both direct and indirect ties with other states. If the map of their relationship is based only on direct ties, then it might miss indirect relationships.

Consider the following example referring to the relationship between states A and B in Figure 1 that shows a hypothetical alliance network. All direct affinity measures between these states (Figure 1.1) yield a score of -1, thus leading us to conclude that the relationship between A and B is decidedly negative. Figure 1.2 shows the second-order relationships in this network (the ally of my ally). State A has a second-order alliance with itself and with D, while B has an alliance with itself and with state C. Figure 1.3 displays the third-order relationships (the ally of the ally of my ally). A and B have an indirect alliance with each other and are also tied to all other members of the network. Figure 1.4 is the reachability graph that includes both direct and indirect alliances.\(^3\) Since A and B are tied to all other members of the network through both direct or indirect ties, they are completely equivalent in terms of their alliance ties and thus would have a perfect affinity score. Thus, looking only at direct relations as an indicator of affinity may lead to misleading or biased insights about relationships.\(^4\)

Why should we care about indirect relationships? The key reason is that some indirect relationships may have a profound impact on direct ones. The notion of “the enemy of my enemy is my friend” represents a fundamental idea in political realism.

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\(^3\) In this particular example it is identical to figure 1.3 but this is not a general case.

\(^4\) If ties represent magnitudes of relations (e.g., percent GDP traded between states), indirect relations are discounted. So if the direct relations in Figure 1.1 between A and C is 0.3 and the direct relation between C and D is 0.5, then the indirect relations between A and D in the second order relationship would be \(0.3 \times 0.5 = 0.15\).
about common enmities that form the basis for common interests (Mearsheimer, 1994/5: 13). It may also have important logical implications for systemic instability (Lee, Muncaster and Zinnes, 1994; Saperstein, 2004). Allies often get entangled in unwanted third-party wars due to chain-ganging processes (Christensen and Snyder, 1990; Snyder, 1997; Maoz, 1990: 193-215). Indirect trade may have profound effects on direct trade because the exports of a trading partner may determine its ability to import from us.

Second, (XXXX, 2004) showed that there exist significant imbalances between direct and indirect relationships in world politics: enemies of enemies can be both allies and enemies simultaneously. States that share linguistic or religious affinities can be both allies and enemies. Thus, first-order measures of affinity may have a different effect on conflict than measures that incorporate both first-order and higher-order affinities.

Third, Tau-b measures assume symmetrical relationships. If state A is aligned with state B, then state B is aligned with state A by definition. However, if we use exports as a measure of affinity then the level of export by state A to state C may not be the same as the level of exports of state C to state A. This creates considerable problems of interpretation.5

Given these problems, we offer an alternative conception of international affinity as part of our attempt to understand international relations as a set of international networks (XXXX., 2005, 2004, 2003a, 2003b). A network is defined as a set of nodes that designate people, groups, institutions, or states and a rule that defines whether and how any two nodes are tied to each other (Watts, 2003: 27; Wasserman and Faust, 1997: 20). This relationship can be described by a given statement such as “lives next to,” “speaks the same language as,” or—in an IR context—“is aligned with,” “trades with,” “has diplomatic relations with,”

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5 The S-R measure can be applied to both symmetrical and asymmetrical relationships. However, the interpretation of the case wherein the Euclidean distance between state i and j is not equal to the Euclidean distance between state j and i on the same issue-space is not straightforward. The Euclidean distance measurement in the social network framework of structural equivalence is both conceptually and mathematically similar to the S-R approach, but is more readily interpretable in the sense that it measures incoming and outgoing distances between units in the network.
and so forth. This relationship can be binary (yes/no), ordinal (level of alliance commitment, rank of diplomatic mission), or ratio-level (e.g., “proportion of GDP due to export to,” “number of people killed in conflict with,” and so forth). Such relationships can be symmetric or asymmetric.

Networks can be displayed as graphs or as sociomatrices. We use the concept of structural equivalence in social networks analysis to tap dyadic affinity. This concept rests on the distinction between direct similarity—defined in terms of the links or ties between two states—and affinity—defined in terms of the similarity between the ties each state has with other states in the system. We start with a conceptual definition of structural equivalence and then define the measure of this concept formally.

Figure 2 about here

Consider the affinity of between states A and B (we can perform a similar analysis for any two members of these systems). In Figure 2.1, A and B are not connected, but they have a similar pattern of ties with other states. All three measures of affinity produce positive and moderately-high affinity scores. In Figure 2.2, A and B have a direct tie, yet they have different relationships with other members of the system. Thus, their affinity scores are much lower. In fact, both the Tau-b and S-R scores are negative with the latter showing a strong negative affinity between the two states. In contrast, the Structural Equivalence (SE) measure reflects affinity in terms of the similarity of ties between each of these states and all other states in the system. This demonstrates rather well between measures of similarity and measures of structural affinity, as we define these here.

Formally, Let $N=[1, 2, \ldots, n]$ represent the set of nodes (states in our case) that make up a given network. Let $R=[R_1, R_2, \ldots, R_r]$ denote a set of relationships (alliances, trade, IGO membership, religious, or linguistic similarity) on which these nodes may or may not be connected. Each network can be defined by a square sociomatrix $X$
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with entries \( x_{ij} \) denoting the relationship between row node \( i \) and column node \( j \) on relation \( r \). We define the structural equivalence of nodes \( i \) and \( j \) on relationship \( r \) as:

\[
SE_{ij}^r = S'( (x_{ik}, x_{jk} ), (x_{ji}, x_{ij} ) ) \quad \forall i, j, k \in N; \ r \in R
\]

where \( S'( (x_{ik}, x_{jk} ), (x_{ji}, x_{ij} ) ) \) is some measure of similarity of the ties going out of \( i \) and \( j \) to any third node \( k \) on relation \( r \), and \( S'( (x_{ik}, x_{jk} ), (x_{ji}, x_{ij} ) ) \) is a measure of similarity of the ties coming in from any node \( k \) to \( i \) and \( j \), respectively.\(^6\) Structural equivalence can be conceived on any given relationship separately, or it can be defined over multiple types of relationships. Thus, we can define separate affinity types in terms of the similarity or dissimilarity of alliance portfolios, trade relations, and diplomatic missions sent and received, and so forth. We can also integrate across the entire set of relationships (alliances, trade, diplomatic missions, etc.), and measure the overall extent of equivalence.

There are different measures of structural equivalence (e.g., Euclidean distances, correlations, or proportion of exact matches between individual profiles of relationships (Wasserman and Faust, 1997: 366-375).\(^7\) The measure we use here is that of bivariate or multiple correlation. Specifically, to measure the structural equivalence between nodes \( i \) and \( j \) on a relationship \( r \), we use the formula for the Pearson product-moment correlation, such that

\[
se_{ij}^r = - \frac{ \sum_{k=1}^{n} (x_{ik} - \overline{x}_i)(x_{jk} - \overline{x}_j) + \sum_{k=1}^{n} (x_{ki} - \overline{x}_j)(x_{ji} - \overline{x}_i)}{\sqrt{ \sum_{k=1}^{n} (x_{ik} - \overline{x}_i)^2 + \sum_{k=1}^{n} (x_{ki} - \overline{x}_j)^2 } \sqrt{ \sum_{k=1}^{n} (x_{jk} - \overline{x}_j)^2 + \sum_{k=1}^{n} (x_{ji} - \overline{x}_i)^2 }}
\]

where \( \overline{x}_i, \overline{x}_j \) are the respective means of the outgoing connections from \( i \) and \( j \) (row means) of Matrix \( X^r \), and \( \overline{x}_j, \overline{x}_i \) are the means of the incoming connections to \( i \) and \( j \),

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\(^6\) Wasserman and Faust (1997: 356-357) use slightly different notations, but the definitions used here are the same as theirs.

\(^7\) There are also different conceptions of equivalence (see Wasserman and Faust, 1997: 461-502; Van Rossem, 1996).
respectively (column means). For any given sociomatrix, and for any pair of nodes, structural equivalence is simply the correlation between two rows $ij$ and the corresponding columns. If we want to measure structural equivalence across a number of different relationships, we simply use the formula for the multiple correlation coefficient, such that

$$SE_{ij} = \frac{\sum_{r=1}^{2R} \sum_{k=1}^{n} (x_{ijk} - \bar{x}_{ij\bullet})(x_{jkr} - \bar{x}_{j\bullet\bullet})}{\sqrt{\sum_{r=1}^{2R} \sum_{k=1}^{n} (x_{ijk} - \bar{x}_{ij\bullet})^2} \sqrt{\sum_{r=1}^{2R} \sum_{k=1}^{n} (x_{jkr} - \bar{x}_{j\bullet\bullet})^2}}$$

[3]

Where the multiple correlation is based on both $\mathcal{R}$ matrices and $\mathcal{R}'$ transposed matrices (hence the relationship index running to $2\mathcal{R}$), and $\bar{x}_{ij\bullet}, \bar{x}_{j\bullet\bullet}$ are the means of the incoming and outgoing ties in the $r$th sociomatrix (Wasserman and Faust, 1997: 369).

How does the measure of structural equivalence overcome the limitations of the current measurement schemes? First, structural equivalence can tap any order of relationship between states. Second, it can be reflect first-order relationships (e.g., direct alliances, direct trade relations), or it can reflect any level of indirect relationship. Third, we can measure structural equivalence scores on the basis on any single relationship or on multiple relationships. For that, we simply revert to multiple correlation coefficients.8

Fourth, our data can reflect a binary (presence or absence) of relationship (the presence or absence of alliances, the presence or absence of diplomatic relations, and so forth), ordinal (the level of alliance commitment or the level of diplomatic mission) or they can measure magnitudes of relationships (e.g., the proportion of a state’s GDP that is due to exports to another state).

Fifth, we can derive structural equivalence scores from either relational or affiliational data (or from a mix of relational and affiliational data). Consider the membership of states in IGOs. Suppose our data consist of a set of states, and a list of IGOs. Entries

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8 It is also possible to weigh multiple correlation coefficients such that some relationships would receive higher weights in the overall affinity scores, as is the case with the S-R measure, but we do not discuss this in the present study.
in this data matrix denote whether or not state $i$ is a member of IGO $g$. This affiliational matrix ($A$) can be converted into a relational network by multiplying it by its transpose ($S = AA'$). Each entry $ij$ in the resulting sociomatrix $S$ denotes the number of IGOs that states $j$ and $i$ share in common. (The diagonal of this matrix, $ii$, denotes the number of IGOs for each state.) The resulting sociomatrix allows integration of an affiliational data into a multiple relationship measurement of structural equivalence.9

Finally, as noted, structural equivalence measures encompass both symmetrical relationships (i.e., $x_{ij} = x_{ji}, \forall i, j \in N$) and directed relationships ($x_{ij} \neq x_{ji}$).

The structural equivalence conception of affinity is more flexible, general, and precise than the previous conceptualizations of affinities between states. It is not only a different way of measuring similarities between states, but an entirely different conception of international affinity defined in structural terms.

4. Research Design

a. Spatial-Temporal Domain

Our study covers all dyads over the period 1816-2002. We use this population to generate the measures of structural equivalence. However, our statistical analyses are performed on the politically relevant dyad population. This population encompasses dyads that are directly or indirectly (through colonial possessions) contiguous, or dyads that include a major power with global reach capacity or a regional power with regional reach capacity (Maoz, 1996: 139-141). The unit of analysis is the dyad-year. We focus on politically relevant dyads because there is no a priori reason to expect that conflict between Costa Rica and Thailand is a function of their alliance or trade relations; these states simply do not have the opportunity to fight (Siverson and Starr, 1997).

b. Data Sources

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9 This operation allows straightforward application of the S-R measure on the converted sociomatrix. On the other hand, to apply the Tau-b score to the relational data requires converting the count entries in the sociomatrix into ordinal levels, thus causing significant loss of information.
1. **Conflicts**: Militarized Interstate Disputes (MID) and War data are taken from the Dyadic MID dataset (Maoz, 2005). Coding rules for these data are documented in Gochman and Maoz (1984), and Jones, Bremer, and Singer (1996).


3. Contiguity, Capability and Alliance data. These are Correlates of War datasets, and are documented and available from the COW2 Website at http://cow2.la.psu.edu/. Stinnet et al., (2002) and Gochman (1991) document the contiguity data. Singer (1990) discusses the military capability. The alliance dataset is documented in Gibler and Sarkees (2004). We also used the Gleditsch and Ward (2001) distance between capitals dataset (http://weber.ucsd.edu/~kgledits/mindist.html). Finally, we also used the newly created Alliance Treaty and Obligations Project (ATOP) dataset compiled by Brett Ashley Leeds: http://atop.rice.edu/home (Leeds, 2003).

4. Trade data. We used the Barbieri (Barbieri, 1996; 2002), Keshk, and Pollins dataset, covering the 1870-1996 period. The data are available at: http://psweb.sbs.ohio-state.edu/faculty/bpollins/papers.htm.

5. Religious and Linguistic Affiliations. The Cultural Dataset was compiled by Phil Schaffer at the University of Michigan and is available upon request. This dataset was used by Henderson (1998, 2004).

6. IGO membership. The IGO dataset is documented by Pevenhouse, Nordstrom, and Wranke (2004) and downloaded from the COW2 Website at http://cow2.la.psu.edu/.

7. The Tau-b and scores of alliance portfolios are generated via the EUGENE engine (Bennett and Stam, 2000a, 2002). We calculate integrative S-R scores via a Euclidean distance metric. All S-R scores are unweighted to allow meaningful comparison to the other measures of affinity.
c. **Dependent Variables**

The dependent variables are the occurrence of a militarized interstate dispute or a war during a given year, such that if a dispute occurred during a given year, the dependent variable (MID or war) received a score of one, and zero otherwise. We examine disputes and wars underway for reasons discussed by Maoz (1998), but we also ran analyses on MIDs and wars begun. Results are basically identical.

d. **Independent Variables**

Structural equivalence scores are measured on five international networks: alliances, trade, IGOs, linguistic, and religious affiliations. Each of these networks has a different structure based on the nature of the data. We discuss each in turn.

**Alliance Structural Equivalence (ALLYSE).** We constructed an alliance network matrix for each year over the 1816-2000 period. Two different types of matrices were constructed for each year. The first matrix, $B_A$, is a binary alliances matrix. The entries in each cell of this matrix $b_{ij}$ indicate whether state $i$ had a formal alliance of any type with state $j$ (score of 1), or not (zero) for that given year. In contrast to conventional social network analysis, and in line with Bueno de Mesquita’s (1981) logic, the main diagonal of the alliance matrix is coded with scores of ones, meaning that each state has a defense pact with itself (it would defend itself if attacked). The second matrix is a valued alliance matrix $V_A$, and uses the ATOP alliance codes. Entries in this matrix are coded as follows. Diagonal cells get a score of one. Cell $v_{ij}$ of this matrix gets a score of 0.75 if states $i$ and $j$ have a defense pact; 0.65 if they had an offensive pact, 0.5 if they had a nonaggression pact; 0.3 if they had a neutrality pact; 0.2 if they had a consultation pact; 0.1 if they did not have a direct pact but shared treaty obligations in an indirect pact, and zero for no alliance. Note that these matrices are symmetrical ($b_{ij}=b_{ji}$, $v_{ij}=v_{ji}$). We then calculated the annual structural equivalence scores for each of the two matrices using equation 2 above.
We also computed third level structural equivalence scores using the following procedure. First, for each year we generated a third-order reachability matrix defined as 

$$AR^3 = \sum_{k=1}^{3} BA^k$$

with entries, $a_{ij}^3$ set at one if state $i$ has a direct, indirect (ally of an ally) or third order (ally of an ally of an ally) relationship with state $j$ and zero otherwise.

We then calculated third-order structural equivalence scores from this matrix as well.\(^{10}\)

**Trade Structural Equivalence (TRADESE).** We followed the same procedure as for the alliance data. The entries in the valued trade matrices $V^T$, $vt_{ij}$ are proportional export figures from state $i$ to state $j$. These entries reflect the proportion of the row state's total trade that is due to trade with the column state.\(^{11}\) Entries in the main diagonal of the matrix are the total volume of trade of state $i$ with all states in the system. Both the binary and valued trade matrices are symmetrical. Entry $bt_{ij}$ in the binary trade matrix for a given year indicates whether state $i$ had any level of trade with state $j$ (score of 1) or not (score of zero). Here too we employed an identical procedure as for the alliance data to compute third-order trade structural equivalence measures.\(^{12}\)

**IGO Membership.** The IGO dataset forms a series of affiliation matrices; each matrix is as $IGA$. These matrices are measured once every five years for the 1815-1965 period and every year thereafter. Each of these matrices was first converted into a sociomatrix defined as $IGO = IGA \times IG A$. Each entry $igo_{ij}$ denotes the number of IGOs that states $i$ and $j$ share in common. Diagonal entries $igo_{ii}$ denote the number of IGO memberships of state $i$. Structural equivalence scores were then computed from the IGO sociomatrices.

Since second-order IGO reachability matrices were usually complete for most years—

---

\(^{10}\) We restricted reachability to third-order relations because most 4th or higher order alliance matrices were empty.

\(^{11}\) These are standardized row figures in which raw export data are divided by the total exports for each state. The reason for using such figures was the high variation in export data (0-1.2 billion dollars). Standardized trade figures provide a more balanced comparison between states with significantly similar trade patterns but highly divergent trade magnitudes due to different size of their economies.

\(^{12}\) Trade-based indices are somewhat problematic. The trade dataset contains about 50% missing data. We treated missing data as no trade. In subsequent investigations we will examine the sensitivity of our SE scores based on trade to different treatments of missing data.
that is, each state had a first or second order SE score of 1.0 with each other state—there was no point in calculating higher order structural equivalence scores for IGO membership. For the period of 1816-1965 we extrapolated structural equivalence periods for missing years such that \( \text{igose}_{ij}^{t+5} = \text{igose}_{ij}^{t+1} + (\text{igose}_{ij}^{t+5} - \text{igose}_{ij}^{t+5})/5 \), where \( \text{igose}_{ij}^{t+5} \) is the structural equivalence score for the \( ij \) dyad in the next half-decade and \( \text{igose}_{ij}^{t+5} \) is the structural equivalence score for the previous half-decade. We ran separate analyses on both extrapolated data and on actually measured data. The results were essentially similar for both versions.

Religious and Linguistic Similarity. The operation of converting religious and linguistic affiliations of states into structural equivalence scores followed the same procedure as for the IGO data. Several issues, however, require explication. First, the basic entry in the affiliation matrices (e.g., RA, LA) is the proportion of the population of state \( i \) that belongs to the religious group \( j \) (or to the linguistic group \( j \)). The resulting sociomatrices have a different interpretation than the IGO sociomatrices. Specifically, the entries in the religious similarity RS matrix \( \langle rs_{ij} \rangle \) denote the proportion of the joint population of both states that practice the same religions. In order to take account of the religious (or linguistic) diversity of each state we inserted in the main diagonal of the matrix the Index of Qualitative Variation (IQV) of the state’s religious or linguistic distribution. The SE scores resulting from these matrices reflect the dyadic similarity of religious portfolios of states, taking into account the degree of religious or linguistic homogeneity of each. The cultural dataset is composed of decade-level observations. To insure comparability with

\[
\text{IQV} = \frac{k(1-\sum_{i=1}^{l} p_i^2)}{k-1}
\]

where \( k \) is the number of religious (or linguistic) groups in the state and \( p_i \) is the proportion of the population of the state belonging to religious/linguistic group \( i \).
the dyad-year unit, we extrapolated between consecutive decade measurements along the lines of the IGO extrapolations.

Validity of Religious and Linguistic SE scores as Measures of Cultural Affinity. As noted, one might question whether “objective” measures of religious and linguistic similarities capture subjective perceptions of affinity. We assess the validity of our measures via two waves of surveys from the Euro-Barometer (Reif and Marlier, 1994; Rabier, Riffault, and Ingelhart, 1980): one from 1980 and one from 1994. These are the only two Euro-Barometer surveys that contain the kind of data we need for our validation test.

These surveys contain questions regarding the trust of respondents in people of various countries. We grouped together the categories “Lot of Trust” and “Some Trust.” Respondents from eleven states in 1980 and twelve states in 1994 were asked to express their level of trust in each of the citizens of these same countries. In addition to the perception of trust that these respondents expressed of other members of the European community, they were asked to rate their level of trust of Americans, Japanese, Russians, and Chinese people.

From these data we constructed three subjective measures of direct similarity and structural affinity. The first measure—entitled Similarity—is simply the proportion of respondents from each state that trust members of the other state. This is based only of perceptions of the (10 states in 1980 and 12 states in the 1994 survey) that were surveyed in these samples. The second measure—entitled SE measure of trust—is based on affiliation matrices of 10 rows (states) in the 1980 survey and 12 in the 1994 survey and 15 columns in the 1980 survey and 14 in the 1994 survey representing peoples whom respondents evaluated in terms of trust. These peoples included both members of the EU and others. Finally, the Trust of Others measure is based only on evaluations by EU mem-

14 The question is: “I would like to ask you a question about how much trust you have in people from various countries. For each, please tell me whether you have a lot of trust, some trust, not very much trust or no trust at all.”
bers of non EU members (Americans, Russians, Japanese, Chinese). From these data we generated structural equivalence scores in the same way we had done for the “objective” religion and language data. We test the validity by correlating the affinity and similarity perceptions of trust with the “objective” religious and linguistic SE scores.

Table 1 about here

The results in Table 1 provide support to the notion that “objective” measures of affinity reflect subjective perceptions of affinity. First, the subjective perceptions SE scores show moderate to high correlations with the “objective” religious and linguistic SE scores. Measures based on perceptions of similarity have low—albeit statistically significant—correlations with the religious and linguistic affinities. These correlations are stable over time, suggesting that the relationship between subjective perceptions of identity and affinity and “objective” measures of these concepts do not appear to fluctuate over periods.

These tests are admittedly quite limited, and the results are somewhat open to a “half-empty”/“half-full” interpretation. Yet they provide empirical support to an assumption that religious and linguistic affinity indices are similar to subjective perceptions of cross-national affinities.

Integrated SE Scores. We used alliances, trade, and IGO sociomatrices to generate a Hypermatrix (Wasserman and Faust, 1997: 154), by joining the three separate matrices for each year where data was available for all three. We then computed the integrated SE scores using the multiple correlation algorithm for the combined matrix. We also generate an integrative measure of cultural affinity based on the multiple correlation SE score of linguistic and religious affinity.

e. Control Variables
As is customary in this genre, we control for variables that are known to affect the probability of dyadic conflict. These variables are the following.

**Regime Structure (MINREG).** We use the weak link Maoz-Russett (1993) regime score (ranging from −90 to 70 in our data).

**Capability Ratios (CAPRAT).** The military capability ratio is computed as the ratio of the strongest member of the dyad to the weakest using the Composite Index of National Capabilities (CINC) score (Kadera and Sorokin, 2004).

**Contiguity.** Since we analyze politically relevant dyads only (Maoz, 1996), we employ the Gleditsch and Ward (2001) distance variable as a reasonable approximation of contiguity that is of an interval rather than a nominal or ordinal nature.

**Traditional Alliance Affinity Measures.** We use the BdM affinity scores as provided in the EUGENE program. The Tau-b alliance affinity scores (Bueno de Mesquita, 1981), designated as TAUBALLY. We also measure the unweighted S-R S scores (SRALLY).

**Years of Peace and Splines.** Following Beck, Katz, and Tucker (1998), we employ peace years (PEACEYRS) and cubic splines of order 1-3 (_SPLINE1, _SPLINE2, _SPLINE3) to control for time-dependence anomalies generated by ordinary logit.

e. Estimation and Comparison of Models

In order to assess the extent to which the measures of structural equivalence improve upon existing measures of affinity, we follow a two-track strategy. First, we start by estimating a baseline equation in which the dependent conflict variable is regressed only on the set of control variables and the splines.

The baseline equation is given by:

\[
p(CONFLICT_{ij} = 1) = \alpha - \beta_1 MINREG_{ij(t-1)} - \beta_2 CAPRAT_{ij(t-1)} + \beta_3 DISTANCE_{ij}
+ \beta_{10} PEACEYRS_{ij} + \sum_{i=10}^{12} \beta_j SPLINE^{*} + \varepsilon
\]  

[4]
Where CONFLICT_{ij,t} is the conflict measure (MID/War) for dyad $ij$ at year $t$. The _SPLINE* variables are the cubic splines of order 1-3.

We then proceed in a sequential manner to introduce the independent variables, up to the point where we reach the full model, given by equation 7 below.

$$p(\text{CONFLICT}_{ij,t} = 1) = \alpha - \beta_1 \text{MINREG}_{ij,t-1} - \beta_2 \text{CAPRAT}_{ij,t-1} + \beta_3 \text{CONTIG}_{ij,t-1} - \beta_4 \text{TAUBALLY}_{ij,t-1} - \beta_5 \text{SRALLY}_{ij,t-1} - \beta_6 \text{ALLYSE}_{ij,t-1} - \beta_7 \text{TRADESE}_{ij,t-1} - \beta_8 \text{RESE}_{ij,t-1} - \beta_9 \text{LANGSE} - \beta_{10} \text{IGOSE} - \beta_{11} \text{PEACEYRS} + \sum_{i=12}^{14} \beta_i \text{SPLINE}* + \epsilon \quad [7]$$

Note that the ALLYSE and TRADESE variables are run twice, once with the first order SE scores, and once with the third-order SE scores. Finally, the individual SE and S-R scores are replaced by the integrated SE and S-R scores, respectively. In addition to running the equations with ordinary logit and cubic splines, we ran the same equations using population-averaged GEE models [with ar(1) correction for autocorrelation]. The results were substantially similar.

In order to evaluate the relative impact of a given set of measures of the affinity variables on the outcome variable we compare the pseudo R-square of this equation to the baseline equation via the following measure:

$$MIF = \frac{R^2_A - R^2_B}{1 - R^2_B} \quad [5]$$

Where MIF is the Marginal Improvement in Fit statistic, $R^2_A, R^2_B$ stand for the $R^2$ measures of the alternative model (including one or more independent variables) and the $R^2$ of the baseline model, respectively.\(^{15}\)

The second strategy is a critical test similar to that used by Maoz and Russett (1993: 633-636) to discriminate between the predictions of the normative and the struc-

\(^{15}\) One may argue that the percent correct prediction is a better estimate of the relative fit of the models. However, given the rare event nature of the nonzero values of the dependent variables, modal predictions perform better than model-based predictions.
tural explanations of the democratic peace. It focuses on the relative performance of the different measures of affinity when they make different predictions about conflict. First, we break the Tau-b, S-R, and SE scores at their respective medians. Values above the median designate high affinity and the remaining values designate low levels of affinity. Next, we deduce the predictions of these measures with respect to the presence or absence of conflict in terms of their levels of affinity. This is given in Table 2.

<table>
<thead>
<tr>
<th>Table 2 about here</th>
</tr>
</thead>
</table>

The first part of the table is a critical comparison of the SE measure against the Tau-b and S-R measures. While there are many possible contrasts, the key test concerns the difference between the adjacent shaded rows. In these cases, the SE measures of affinity generate different predictions from those generated by the alternative measures. Since the Tau-b score is available and meaningful only for alliance portfolios, we restrict the presentation to this variable.

The second part of the table shows critical tests for each of the affinity-conflict linkages according to the three paradigms. For example, we contrast cases in which two states share a high level of trade-based affinity but a low level of strategic affinity (thus are expected to have low levels of conflict by the liberal approach but high level of conflict by the realist approach) with cases wherein the states have a low level of trade-based affinity and a high strategic affinity (thus, are expected to have high conflict by the liberal approach but low conflict by the realist approach). Similar tests are conducted for all other combinations of the models.

5. **Empirical Results**

We start by discussing correlations between the various structural equivalence measures, as well as the correlations between SE measures and the alliance-based measures of affinity used by BdM and S-R. There are three sets of correlations to consider.
First, the correlations between our measures of structural equivalent and the Tau-b and S-R affinity measures are moderate-high to moderate (SEALLY-TAUALLY, \( r = 0.780 \); TAUALLY-S-R \( r = 0.391 \); SEALLY-S-R, \( r = 0.290 \), N=62,102). Second, the correlations among different structural equivalence scores are generally in the low twenties (average \( r \) between the measure of structural equivalence of any two relationships is 0.21). The only exception is the high correlation between measures of SE based on linguistic similarity and those based on religious similarity (SERELIG-SELANG \( r = 0.751 \), N=72,182).16 Third, correlations of first-order affinity with third-order affinity measures are—generally speaking—low-to-medium (average \( r = 0.271 \)). The exception is the relatively strong relationship between first and third-order measures of SEALLY (\( r = 0.623 \)).

These correlations suggest that most of the affinity-related indices should be expected to have independent effects on conflict among states. We now move to a test of the effects of the various structural measures of dyadic affinity on the probability of MIDs or wars between states.

Table 3 does not report the comparison of the marginal effects of the SE vis-à-vis the Tau-b and S-R measures of affinity. These results are available in the replication Website of the project (http://xxxx.edu). Generally speaking, strategic affinity as measured either by TAUBALLY or by SRALLY is negatively related to the probability of dyadic conflict, but the marginal improvement in fit over the basic model is negligible. When we add the SE measure of affinity, we find all measures of strategic affinity have a significant negative impact on the probability of dyadic conflict. Here too, the improvement in fit is almost nil.

---

16 Ns for the correlations vary between 537,981 and 683,547, so that even very low correlations are statistically significant.
We turn to the interpretation of the general results on affinity and conflict. The leftmost columns in both parts of Table 3 (models 1 and 4) provide the results of the baseline models that include only the control variables. Model 2 tests the effect of the full array of affinities on the probability of dyadic conflict. Here we note several things. First, strategic affinity continues to have a negative impact on conflict, in accordance with the predictions of the realist paradigm. The predictions of the liberal and culturalist paradigms receive mixed support. Trade and religious affinity do not have a significant effect on conflict behavior, but IGO-related affinity has a significantly dampening effect on dyadic conflict while linguistic affinity has a positive effect on conflict. Model 5 examines the effect of third-order affinity on dyadic war. It shows that third order alliance does not have a significant effect on the probability of dyadic war. Third-order trade affinity has a significant positive effect on the probability of war, suggesting that similar direct and indirect trade portfolios represent competitive relations and increase the probability of war. This model shows a marked improvement in fit over the baseline model, reducing the unexplained variance of the baseline model by almost sixteen percent.

Finally, models 2 and 6 examine the effect of the integrated measures of affinity on the probability of MIDs and war. The integrated SE measure incorporates alliance, trade, and IGO-related relations. The cultural SE measures integrates religious and linguistic relations. The integrated SE measure has a negative impact on the probability of war. However, the integrated cultural SE measure does not have a statistically significant impact on the probability of war.

By and large, the control variables exhibit consistently significant effects on dyadic conflict, in accordance with previous studies linking regime scores, capability ratios, and contiguity to dyadic conflict (e.g., Bremer, 2000).
In Table 4 we examine cross-temporal variations in the effects of affinity on conflict as a means of assessing robustness. The findings suggest that the negative effect of the alliance SE score on conflict is quite robust over time. Religious and Linguistic affinities, on the other hand, do not appear to have any meaningful effect on the probability of dyadic MIDs and wars, and this also appears to be a robust finding. The negative effect of trade on conflict is limited to the twentieth century only, and there too it is not robust with respect to the measure of conflict. IGO-related structural equivalence has a negative impact on dyadic MIDs and Wars only in the twentieth century.17

The integrated SE measure of affinity has a negative and robust impact on both MIDs and wars. Finally, the integrated cultural affinity score has a positive effect on the probability of dyadic war especially in the 20th century. The full model provides a substantial improvement in fit with respect to wars (over 15 percent), but only a negligible improvement in fit relative to the baseline model with respect to MIDs.

We turn now to the critical test of the measures of affinity. We contrast the cases wherein the SE measure predicts no conflict and the other measures predict conflict with the cases in which the SE measure predicts conflict and the other measures predict no conflict. The results of this comparison are given in Table 5 below.

Table 5 suggests that, by and large, the structural equivalence measure of affinity provides a more accurate assessment of the probability of dyadic MIDs and wars than either of the two alternative measures. The bivariate comparisons between the different affinity scores suggest that conflict rates are consistently more compatible with the SE predictions than with the other measure of affinity. This holds for all MID-based com-

17 We ran similar analyses on separate indices of alliance, trade, IGO, linguistic, and religious affinity using the S-R measure. The results for the S-R measure were generally speaking similar to the SE measures. The improvement in fit was somewhat lower than for the SE measures but not significantly so.
parisons. For wars, the results are consistent with the bivariate comparisons, but the differences are not significant in the comparison between the integrated affinity measures. Neither are the multivariate comparisons statistically significant.

Table 6 compares the predictions of the realist, liberal, and cultural perspectives. Several findings are worth noting. First, the relationship between affinity and conflict are consistently more compatible with the realist paradigm’s prediction than with either the liberal or the cultural predictions. This applies to most pairwise comparisons, except the war-related comparison between IGO affinity and the alliance-based affinity. This suggests that strategic affinity seems to provide a significantly better account of the effect of common interests on conflict than the liberal account or the cultural paradigms suggest.

Second, the comparison of the cultural conceptions of affinity to the liberal ones displays mixed results, but many of the results are not statistically significant. All in all, the critical tests suggest that the realist model fares fairly well compared to the other approaches. The liberal and cultural paradigms are not significantly distinguishable in terms of the relative accuracy of their conflicting predictions.

6. Conclusion

This study offers one of the first systematic analyses of how different conceptions of structural affinity affect dyadic conflict. Several findings emerge.

1. Strategic affinity—defined both in terms of more traditional measures of alliance portfolio similarity (Tau-b and S-R), and in terms of first- and third-order structural equivalence of alliance commitments—reduces the probability of MIDs and war. This finding is fairly robust across spatial and temporal stratifications. This supports the realist claim that strategic affinity, defined in terms of common interests, reduces the probability of conflict between states.
2. Liberal conceptions of affinity—defined in terms of trade IGO-based relations—receive some support, but this is not as robust and consistent as in the case of strategic affinity.

3. Cultural affinities reflecting the propositions of the cultural approach do not seem to have a statistically significant effect on dyadic conflict. Nor is this effect consistent when the effect of cultural affinity on conflict is significant.

4. Integrated measures of structural equivalence that incorporates trade, alliances, and IGO-based relations seems to have a consistently negative effect on the probability of conflict. This suggests that an integrated perspective of world politics—one that includes both realist and liberal notions of conflict and cooperation—has a significant theoretical and empirical potential.

5. Conceptualizations of affinity that are based on indirect associations between dyad members and third parties have also a significant predictive potential with regard to the probability of dyadic conflict.

6. The full range of affinities—strategic, economic and institutional, and cultural—provide, however, only a slight improvement in fit compared to the baseline model that contains only the control variables. However, the integrated affinity measures provide a significantly better fit to the data than the baseline model. This suggests that an integrative approach to the study of dyadic affinity adds a good deal of predictive ability to our explanations of the sources of dyadic conflict.

7. The critical tests suggest that the measures of structural equivalence provide better predictions of dyadic conflict than the Tau-b and S-R scores. The critical test of the propositions derived from the various models corroborate the general findings of this study: strategic affinity tends to be a more potent predictor of the propensity of dyads to engage in conflicts than either liberal or cultural affinity.
We believe that this study contributes to knowledge about international politics in general and international conflict, in particular in several ways. First, it offers a new perspective of international relations as different dimensions of international affinities, one that considers not only direct ties between states, but also how these states are tied to other states or entities in the system. This approach allows deriving hypotheses about affinity and behavior from existing paradigms of world politics, as well as theorizing about these matters in terms of new or integrative models. This opens the door to new or more complex ideas about the structure of relations among states and their effects on conflict and cooperation in world politics.

Our results suggest that this approach offers a superior strategy compared to previous efforts at measuring and employing this concept. We need to explore additional dimensions of affinity, such as diplomatic relations, voting patterns and regime structure. These new dimensions of dyadic affinity can be studied either in isolation or they can be integrated into one comprehensive conception.

Second, this study suggests the usefulness of social networks approaches to the study of international politics. International politics is about relations between states. The structure and dynamics of these relations can be systematically modeled by social networks analysis. We presented only one facet of this approach here, but other applications may shed light on various aspects of conflict and cooperation at the national, dyadic, and systemic levels of analysis (XXXX, 2005; Hoff and Ward, 2004).
Bibliography


Structural Equivalence and International Conflict, 1816-2000


Table 1: Validity Tests for Structural Equivalence Scores of Religious and Linguistic Affinities, 1980 and 1994 European Community Samples

<table>
<thead>
<tr>
<th></th>
<th>1980 Euro-Barometer</th>
<th>1994 Euro-Barometer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SE measure of Trust</td>
<td>Trust of Others</td>
</tr>
<tr>
<td>N</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Religious SE</td>
<td>0.561**</td>
<td>0.649**</td>
</tr>
<tr>
<td>Linguistic SE</td>
<td>0.780**</td>
<td>0.866**</td>
</tr>
<tr>
<td>Cultural SE</td>
<td>0.306**</td>
<td>0.466**</td>
</tr>
</tbody>
</table>

Notes:
1. N for SE measure of trust and Trust of Others and are based on non-directed dyads because $SE_{ij} = SE_{ji}$. Ns for similarity measures are based on directed dyads because $SIM_{ij} \neq SIM_{ji}$.

** $p < 0.01$; * $p < 0.05$
Table 2: 2.1. Critical Tests of Different Measures of Affinity

<table>
<thead>
<tr>
<th>Level of TAUBALLY</th>
<th>Level of SRALLY</th>
<th>Level of SEALLY</th>
<th>TAUALLY prediction</th>
<th>SRALLY prediction</th>
<th>SEALLY prediction</th>
<th>Type of case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>—</td>
<td>High</td>
<td>Conflict</td>
<td>No Conf.</td>
<td>—</td>
<td>Conflict</td>
</tr>
<tr>
<td>High</td>
<td>—</td>
<td>Low</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>Critical</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>High</td>
<td>Conflict</td>
<td>No Conf.</td>
<td>Conflict</td>
<td>Critical</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>Low</td>
<td>—</td>
<td>—</td>
<td>Conflict</td>
<td>Critical</td>
</tr>
</tbody>
</table>

Multivariate—SE Ally against the rest

<table>
<thead>
<tr>
<th>Level of Trade SE</th>
<th>Level of IGO SE</th>
<th>Level of SEALLY</th>
<th>Trade SE prediction</th>
<th>IGO SE prediction</th>
<th>Ally SE prediction</th>
<th>Type of case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>—</td>
<td>High</td>
<td>Conflict</td>
<td>No Conf.</td>
<td>—</td>
<td>No Conf.</td>
</tr>
<tr>
<td>High</td>
<td>—</td>
<td>Low</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>Conflict</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>High</td>
<td>Conflict</td>
<td>No Conf.</td>
<td>Conflict</td>
<td>No Conf.</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>Low</td>
<td>—</td>
<td>—</td>
<td>Conflict</td>
<td>No Conf.</td>
</tr>
</tbody>
</table>

2.2. Critical Test of Different Models of Affinity

<table>
<thead>
<tr>
<th>Level of Cultural SE</th>
<th>Level of SEALLY</th>
<th>Cultural SE prediction</th>
<th>Relig. SE prediction</th>
<th>Ally SE prediction</th>
<th>Type of case</th>
</tr>
</thead>
<tbody>
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<td>Low</td>
<td>Conflict</td>
<td>No Conf.</td>
<td>—</td>
</tr>
<tr>
<td>High</td>
<td>Low</td>
<td>—</td>
<td>—</td>
<td>—</td>
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</tr>
<tr>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>Conflict</td>
<td>No Conf.</td>
<td>Conflict</td>
</tr>
<tr>
<td>High</td>
<td>Low</td>
<td>—</td>
<td>—</td>
<td>Conflict</td>
<td>No Conf.</td>
</tr>
</tbody>
</table>

Where:
TAUALLY = Tau-b measure of alliance portfolios similarity
SRALLY = S-R measure of alliance portfolios similarity
SEALLY = Structural equivalence measure of alliance portfolios
Trade SE = Structural equivalence measure of trade-based affinity
IGO SE = Structural equivalence measure of IGO-affiliation affinity
Cultural SE = Structural equivalence measure of cultural (integrated linguistic and religious) affinity
Table 3: Logit Analysis of the Effects of Structural Equivalence Measures of Affinity and Control Variables on Dyadic International Conflict, 1816-2000

<table>
<thead>
<tr>
<th>Independent/Control Variable</th>
<th>Model 1 (Baseline)</th>
<th>Model 2</th>
<th>Model 3 (Integ. SE)</th>
<th>Model 4</th>
<th>Model 5</th>
<th>Model 6 (Integ. SE)</th>
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<tbody>
<tr>
<td></td>
<td>MIDs</td>
<td></td>
<td></td>
<td>War</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum regime Score</td>
<td>-0.004**</td>
<td>-0.005**</td>
<td>-0.004**</td>
<td>-0.005**</td>
<td>-0.009**</td>
<td>-0.009**</td>
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<tr>
<td>(0.001)</td>
<td>(0.001)</td>
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<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
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<tr>
<td>Capability Ratio</td>
<td>-0.001**</td>
<td>-0.001**</td>
<td>-0.001**</td>
<td>-0.010**</td>
<td>-0.010**</td>
<td>-0.007**</td>
</tr>
<tr>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td></td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.003)</td>
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<td>-0.001**</td>
<td>-0.000**</td>
<td>-0.000**</td>
<td>0.000</td>
<td>-0.000</td>
<td>0.000</td>
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<tr>
<td>Linguistic SE</td>
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<td>-0.302**</td>
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<td>-0.623**</td>
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<td></td>
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<td>(0.091)</td>
<td></td>
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<td>(0.186)</td>
<td>(0.186)</td>
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<td>(0.232)</td>
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<td>Integrated Cultural SE (religious linguistic)</td>
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<td>(0.168)</td>
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<td>Constant</td>
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<td>0.830</td>
<td>0.566*</td>
<td>-1.380**</td>
<td>0.765*</td>
<td>0.779**</td>
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<td>(0.037)</td>
<td>(0.112)</td>
<td>(0.047)</td>
<td>(0.098)</td>
<td>(0.330)</td>
<td>(0.160)</td>
</tr>
<tr>
<td>Model Statistics</td>
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<td>N=56,126</td>
<td>N=70,332</td>
<td>N=80,092</td>
<td>N=64,598</td>
<td>N=70,408</td>
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<td></td>
<td>χ² = 8,464.1</td>
<td>χ² = 7,617.0</td>
<td>χ² = 9,476.3</td>
<td>χ² = 3,352.3</td>
<td>χ² = 3,050.7</td>
<td>χ² = 3,784.9</td>
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<tr>
<td></td>
<td>R² = 0.378</td>
<td>R² = 0.417</td>
<td>R² = 0.415</td>
<td>R² = 0.485</td>
<td>R² = 0.566</td>
<td>R² = 0.543</td>
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<td>MIF = 0.063</td>
<td>MIF = 0.061</td>
<td>MIF = 0.061</td>
<td>MIF = 0.157</td>
<td>MIF = 0.157</td>
<td>MIF = 0.113</td>
</tr>
</tbody>
</table>

Notes:
1. Estimates of spline and years of peace variables are not presented here due to space constraints.
2. Ns vary due to missing data and different time spans for individual variables.

* p < 0.05
** p < 0.01
### Table 4: Structural Equivalence and Dyadic Conflict: Periodic Breakdown of Logit Analyses

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<td>Minimum regime Score</td>
<td>0.001</td>
<td>-0.006**</td>
<td>-0.006**</td>
<td>-0.004</td>
<td>-0.008**</td>
<td>-0.012**</td>
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<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.004)</td>
<td>(0.002)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Capability Ratio</td>
<td>-0.003**</td>
<td>-0.003**</td>
<td>-0.003**</td>
<td>-0.014**</td>
<td>-0.008**</td>
<td>-0.012**</td>
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<tr>
<td></td>
<td>(0.001)</td>
<td>(0.000)</td>
<td>(0.001)</td>
<td>(0.005)</td>
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<td>Distance</td>
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<td>-0.000**</td>
<td>0.000*</td>
<td>0.000</td>
<td>0.000*</td>
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<tr>
<td></td>
<td>(0.001)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
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<tr>
<td>Alliance SE, 1st order</td>
<td>-0.581*</td>
<td>-0.408**</td>
<td>-0.281**</td>
<td>-0.417</td>
<td>-0.685**</td>
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<td></td>
<td>(0.256)</td>
<td>(0.092)</td>
<td>(0.107)</td>
<td>(0.554)</td>
<td>(0.247)</td>
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<tr>
<td>Trade SE, 1st order</td>
<td>0.050</td>
<td>0.078</td>
<td>-0.226*</td>
<td>—</td>
<td>-0.293</td>
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<td></td>
<td>(0.158)</td>
<td>(0.112)</td>
<td>(0.101)</td>
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<td>(0.279)</td>
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<td>Linguistic SE</td>
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<td>0.046</td>
<td>-0.155</td>
<td>0.050</td>
<td>0.181</td>
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<tr>
<td></td>
<td>(0.158)</td>
<td>(0.104)</td>
<td>(0.145)</td>
<td>(0.309)</td>
<td>(0.236)</td>
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<tr>
<td>Religious SE</td>
<td>-0.042</td>
<td>-0.018**</td>
<td>0.144</td>
<td>0.306</td>
<td>-0.321</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>(0.099)</td>
<td>(0.112)</td>
<td>(0.168)</td>
<td>(0.219)</td>
<td>(0.259)</td>
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<td>IGO SE</td>
<td>0.091</td>
<td>-0.522**</td>
<td>-0.611**</td>
<td>-0.306</td>
<td>-1.008**</td>
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<td></td>
<td>(0.118)</td>
<td>(0.106)</td>
<td>(0.158)</td>
<td>(0.240)</td>
<td>(0.214)</td>
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<td>Integrated SE (Alliance, trade, IGOs)</td>
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<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>-0.803*</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.395)</td>
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<tr>
<td>Integrated Cultural SE (religious linguistic)</td>
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<td>—</td>
<td>—</td>
<td>0.908**</td>
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<td></td>
<td>(0.297)</td>
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<tr>
<td>Constant</td>
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<td>0.414**</td>
<td>0.048</td>
<td>-1.922**</td>
<td>1.651</td>
<td>-0.176</td>
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<td>(0.035)</td>
<td>(0.157)</td>
<td>(0.220)</td>
<td>(0.739)</td>
<td>(0.338)</td>
<td>(0.306)</td>
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<td>LR $\chi^2$ = 3,975.12</td>
<td>LR $\chi^2$ = 2,503.08</td>
<td>LR $\chi^2$ = 419.10</td>
<td>LR $\chi^2$ = 1,598.05</td>
<td>LR $\chi^2$ = 1,163.97</td>
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<td>Pseudo R$^2$ = 0.206</td>
<td>Pseudo R$^2$ = 0.317</td>
<td>Pseudo R$^2$ = 0.350</td>
<td>Pseudo R$^2$ = 0.356</td>
<td>Pseudo R$^2$ = 0.463</td>
<td>Pseudo R$^2$ = 0.602</td>
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<td>MIF= 0.052</td>
<td>MIF=0.044</td>
<td>MIF=0.069</td>
<td>MIF=0.160</td>
<td>MIF=0.165</td>
<td>MIF=0.245</td>
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Table 5: Critical Test of the Probability of Dyadic Conflict Given the Predictions of Different Measures of Dyadic Affinity

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<tr>
<th>Level of TAUB-ALLY</th>
<th>Level of SRALLY</th>
<th>Level of SEALLY</th>
<th>TUBALLY prediction</th>
<th>SEALLY prediction</th>
<th>Prop. MID (N MIDs)</th>
<th>Z-Score</th>
<th>Prop. War (N)</th>
<th>Z-Score</th>
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<td><strong>Bivariate comparisons</strong></td>
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<tr>
<td>Low</td>
<td>—</td>
<td>High</td>
<td>Conflict</td>
<td>—</td>
<td>No Conflict</td>
<td>0.061</td>
<td>(539)</td>
<td>-7.100**</td>
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<tr>
<td></td>
<td>High</td>
<td>—</td>
<td>No Conflict</td>
<td>—</td>
<td>Conflict</td>
<td>0.047</td>
<td>(183)</td>
<td>-4.306**</td>
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<tr>
<td>—</td>
<td>Low</td>
<td>High</td>
<td>Conflict</td>
<td>—</td>
<td>No Conflict</td>
<td>0.036</td>
<td>(367)</td>
<td>-4.394**</td>
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<td>—</td>
<td>High</td>
<td>Low</td>
<td>No Conflict</td>
<td>—</td>
<td>Conflict</td>
<td>0.049</td>
<td>(503)</td>
<td>-1.980*</td>
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<tr>
<td><strong>Integrated SE Scores</strong></td>
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<tr>
<td>—</td>
<td>Low</td>
<td>High</td>
<td>Conflict</td>
<td>—</td>
<td>No Conflict</td>
<td>0.032</td>
<td>(28,372)</td>
<td>-2.003*</td>
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<td>—</td>
<td>High</td>
<td>Low</td>
<td>No Conflict</td>
<td>—</td>
<td>Conflict</td>
<td>0.035</td>
<td>(29,782)</td>
<td>-0.649</td>
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<td><strong>Multivariate Comparison</strong></td>
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<tr>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>Conflict</td>
<td>Conflict</td>
<td>No Conflict</td>
<td>0.037</td>
<td>(374)</td>
<td>-4.210**</td>
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<tr>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>No Conflict</td>
<td>No Conf.</td>
<td>Conflict</td>
<td>0.049</td>
<td>(502)</td>
<td>0.806</td>
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</table>

Notes: Difference-of-proportions: 
\[ Z = \frac{n \left( p(\text{conf} \mid \text{allyse}) - p(\text{conf} \mid \text{alter.}) \right)}{\sqrt{\frac{\hat{p}(1-\hat{p})}{N(\text{conf} \mid \text{allyse})} + \frac{1}{N(\text{conf} \mid \text{alt})}}} \] and 
\[ \hat{p} = \frac{n(\text{conf} \mid \text{allyse})}{n(\text{conf} \mid \text{allyse}) + n(\text{noconf} \mid \text{allyse})} \]

where \( p(\text{conf} \mid \text{allyse}) \) is the proportion of conflict (MID, War) cases given the prediction of conflict by SEALLY and \( p(\text{conf} \mid \text{alter}) \) is the relative proportion of conflict cases given the prediction of conflict by the alternative measure(s), and \( N(\text{conf} \mid x) \) is the respective number of cases from which the proportions were drawn.
Table 6: Critical Tests Comparing Different Models of Affinity and Conflict

<table>
<thead>
<tr>
<th>Level of Trade SE</th>
<th>Level of IGO SE</th>
<th>Level of SEALLY</th>
<th>Trade SE Prediction</th>
<th>IGO SE Prediction</th>
<th>SEALLY prediction</th>
<th>Prop. MID (N)</th>
<th>Z-Score</th>
<th>Prop. War (N)</th>
<th>Z-Score</th>
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<td><strong>The Realist vs. Liberal Model</strong></td>
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</tr>
<tr>
<td>Low</td>
<td>—</td>
<td>High</td>
<td>Conflict</td>
<td>—</td>
<td>No Conflict</td>
<td>0.044</td>
<td>(472)</td>
<td>0.007</td>
<td>(80)</td>
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<tr>
<td>High</td>
<td>—</td>
<td>Low</td>
<td>No Conflict</td>
<td>—</td>
<td>Conflict</td>
<td>0.054</td>
<td>(919)</td>
<td>0.009</td>
<td>(159)</td>
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<tr>
<td>—</td>
<td>Low</td>
<td>High</td>
<td>—</td>
<td>Conflict</td>
<td>No Conflict</td>
<td>0.043</td>
<td>(382)</td>
<td>0.011</td>
<td>(101)</td>
</tr>
<tr>
<td>—</td>
<td>High</td>
<td>Low</td>
<td>—</td>
<td>No Conflict</td>
<td>Conflict</td>
<td>0.052</td>
<td>(1,014)</td>
<td>0.068</td>
<td>(134)</td>
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</tbody>
</table>

**Realist vs. Cultural Models**

<table>
<thead>
<tr>
<th>Level of Cultural SE</th>
<th>Level of SEALLY</th>
<th>Cultural SE Prediction</th>
<th>SEALLY prediction</th>
<th>Prop. MID (N)</th>
<th>Z-Score</th>
<th>Prop. War (N)</th>
<th>Z-Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>High</td>
<td>Conflict</td>
<td>No Conflict</td>
<td>0.032</td>
<td>(425)</td>
<td>0.006</td>
<td>(80)</td>
</tr>
<tr>
<td>High</td>
<td>Low</td>
<td>No Conflict</td>
<td>Conflict</td>
<td>0.049</td>
<td>(662)</td>
<td>0.009</td>
<td>(115)</td>
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</tbody>
</table>

**Cultural vs. Liberal Models**

<table>
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<th>Level of Cultural SE</th>
<th>Level of Trade SE</th>
<th>Cultural SE Prediction</th>
<th>Trade SE prediction</th>
<th>Prop. MID (N)</th>
<th>Z-Score</th>
<th>Prop. War (N)</th>
<th>Z-Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>High</td>
<td>Conflict</td>
<td>No Conflict</td>
<td>0.049</td>
<td>(584)</td>
<td>0.009</td>
<td>(118)</td>
</tr>
<tr>
<td>High</td>
<td>Low</td>
<td>No Conflict</td>
<td>Conflict</td>
<td>0.046</td>
<td>(626)</td>
<td>0.007</td>
<td>(97)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level of Cultural SE</th>
<th>Level of IGO SE</th>
<th>Cultural SE Prediction</th>
<th>IGO SE Prediction</th>
<th>Prop. MID (N)</th>
<th>Z-Score</th>
<th>Prop. War (N)</th>
<th>Z-Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>High</td>
<td>Conflict</td>
<td>No Conflict</td>
<td>0.036</td>
<td>(495)</td>
<td>0.005</td>
<td>(66)</td>
</tr>
<tr>
<td>High</td>
<td>Low</td>
<td>No Conflict</td>
<td>Conflict</td>
<td>0.036</td>
<td>(500)</td>
<td>0.008</td>
<td>(114)</td>
</tr>
</tbody>
</table>
Figure 1: First, Second and Third-Order Alliance Ties in a Hypothetical System

1st Order Affinity Scores for States A & B
- Tau-b = -1
- S-R = -1
- SE = -1.0

2nd Order Affinity

3rd Order Affinity

Reachability
SE = 1.0

Figure 1.1

Figure 1.2

Figure 1.3

Figure 1.4
Figure 2: Structural Equivalence in Two Hypothetical Networks

System 1

A → B
C → D
E → F
G

System 2

A → B
C → D
E → F
G

Affinity Scores

System 1

Tau-b = 0.481
S-R = 0.429
SE = 0.417

System 2

Tau-b = -0.154
S-R = -0.714
SE = 0.167