The North/South Divide in NGO
Hyperlink Networks

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Globalization and communication scholars have argued that technology is transforming the “third sector,” the set of organizations that are not-for-profit and non-governmental (NGOs). This research examines the local and global linkages among a hyperlink network of 248 HIV/AIDS NGOs. This research examines the north/south NGO divide in the context of these new technology-based associations. Results suggest that the north/south divide is as great a concern in the virtual world as it is in the physical one. This research implies that globalization theorists’ argument that communication technologies break down economic and geographic barriers may be overstating the empirical reality.


According to the 2006 UNAIDS report, approximately 40 million people globally are living with HIV and approximately 4.5 million contracted the virus in 2006. There are currently 17 times more HIV cases in the global south (i.e., Africa, Asia, Latin America, Eastern Europe) than in the global north (i.e., North America, Western Europe, Oceania). It goes without saying that the regions most devastated by this pandemic have the fewest internal resources to deal with it. Thus, connections between those working in the global north to address HIV/AIDS and those organizations indigenous to the global south have important implications for the global ability to address this disease.

Case studies abound of non-profit, non-governmental organizations’ (NGOs) use of information communication technologies (ICTs) to cross vast distances. The Zapatista movement, an indigenous movement in Chiapas, Mexico, somewhat famously used ICTs to alert activists in the global north of their plight and was able to influence their government indirectly through the governments of the global north (Castells, 1997; Ronfeldt, Arquilla, Fuller, & Fuller, 1998). In another case study, Juris (2004) argues that the global justice movement demonstrates that NGOs using ICTs are performing “globalization from below,” due to the truly
global distribution of the movement’s network. However, successful use of ICTs has not been universal because some NGO movements have not changed the scope of their network connections. For example, Dubash and Oppenheimer (1992) note that the sustainable development movement in the global south has been characterized as local, grassroots and non-influential in international governance, while the sustainable development movement in the global north has been characterized as policy-centered, influential in international governance and out of touch with the plight of the global south. As such, the global south and the global north have few connections in the sustainable development movement. Research on the Zapatista movement, the global justice movement and the sustainable development movement represent three views of the way that NGO networks, facilitated by ICTs, are transforming or not transforming interorganizational relationships around the globe.

The purpose of this research is to explore the way that NGO networks are structured across the globe. In particular, we examine the role of region and the north/south divide in shaping hyperlink networks. As such, this research will make two contributions to the literature. This research moves current NGO research on the north/south divide beyond the case study approach of examining a NGO or single movement. As such, it promises to test some of the conclusions of these case studies. Second, we examine a hypothesis posed in globalization research, namely that Internet technology is transforming spatial relations (Castells, 1996; Rutherford, 2000). Specifically, we define transformed spatial relations as similarity in the relative position of NGOs in the global hyperlink network irrespective of location.

This research is organized as follows: First, NGOs are defined, and the literature surrounding their use of technology is discussed. Second, we introduce the current literature on globalization and the transformation of spatial relations. Third, we introduce hypotheses concerning the influence of spatial relations on the hyperlink network. Fourth, the method, analysis and results of this study are discussed. Fifth, the implications of this study are highlighted.

**Literature Review**

This research, following Khagram, Riker and Sikkink (2002), defines NGOs as “private, voluntary, nonprofit groups whose primary aim is to influence publicly some form of social change” (p. 6). The growth and increasing influence of NGOs makes them prime subjects for study (Anheier & Themudo, 2005). The number, size, professionalism, speed, density and complexity of transnational advocacy networks, a type of NGO network, have grown dramatically over the past four decades (Keck & Sikkink, 1998). Because of the growth of this sector, and because of their increasing influence both domestically and internationally (Boli & Thomas, 1997; Khagram, Riker, & Sikkink, 2002), these organizations and their relationships are important areas of study for organizational communication scholars.

The use of ICTs has dramatically influenced the NGO sector. These changes include the nature of membership (Bimber, Flanagin, & Stohl, 2005), protest (Scott
& Street, 2000), media coverage (Downing, 2001), and the dispersion of membership across space and time (Shumate & Pike, 2006). Increasingly, ICTs are providing new ways for organizations to cooperate with one another.

One important technology for NGOs is the organizational website. Rogers and Marres (2000) and Ackland and Gibson (2004) note that NGOs frequently use websites to promote cyberactivism, to provide information to publics and, to link to other organizations. A NGO’s website is its virtual presence.

This research examines a network of HIV/AIDS NGO websites. HIV/AIDS NGOs include activist, research, service, and membership organizations (Altman, 1999; Jönsson & Söderholm, 1995). Despite their differences in approaches, a common issue unites these organizations into an issue industry (see Shumate, Fulk & Monge, 2005). While these NGOs are unique in the short history of their issue and industry (i.e. 1983 to present), the international interest and legislative bodies surrounding that industry, and the extent of private/public funding for this issue, this sector is similar to other NGO sectors in their use of technology and motivations for a NGO network (Patton, 2002).

Hyperlink Networks
In June 2006, the Annenberg School for Communication at the University of Pennsylvania held the “Hyperlink Society” conference. The rationale for the conference stated that hyperlinks are not only the means for connecting creative works together, but they establish which people and ideas have the right to be heard and their ranking in matter of importance. They assert that links have intrinsic value and serve to privilege some ideas, people, and organizations over others (The Hyperlinked Society, 2006). This deeper meaning for hyperlinks provides a justification for assessing this connective form of communication. Websites can be viewed as unique entities and hyperlinks as symbolic of the relationships between the entities (Ding, Zha, He, Husbands, & Simon, 2004; Park, 2003). Hyperlinks are evidence of the interrelated nature of a community of organizations (Ackland & Gibson, 2004; Wellman, 2001) and these hyperlink networks are of increasing interest and importance (Thelwall, 2005).

Hyperlink networks have been characterized as the “heart” of the Internet, a strategic marketing tool, and a reflection of human culture (Dysart, 2002; Giuffo, 2002; Pennock, Flake, Lawrence, Glover, & Giles, 2002). Hyperlink networks have meaning and are fundamental elements of community creation. Foundational to the understanding that hyperlinks represent communities is their intentionality. These links do not happen automatically or at random. The decision to link one organization with another is a strategic communicative choice (Bach & Stark, 2004; Dysart, 2002; Garrido & Halavais, 2003; Jackson, 1997; Kleinberg, Lawrence, Lawrence, Pennock, Lawrence, Giles et al., 2001; Tremayne, 2004).

Many earlier scholars have identified communicative acts as those which hold meaning for the receiver (Burke, 1965; Watzlawick, Beavin, & Jackson, 1967). Numerous hyperlinks into a site can establish trust (Palmer, Bailey, & Faraj, 2000) and authority (Chakrabarti et al., 1999; Kleinberg, 1999). To link to another website
is to validate them, giving the linked organization legitimacy or endorsement (Biermann, Golladay, Greenfield, & Baker, 1999; O’Neil & Ackland, 2006; Vreeland, 2000). Refusing or neglecting to link to another organization carries its own significant message. Rogers and Marres (2000) explain that the linking of one organization to another and the degree to which linking is reciprocal is the way in which organizations acknowledge each other.  

Previous hyperlink research has investigated academic networks, intergovernmental networks, and networks formed within specific countries. Thelwall (2002, 2003) has used qualitative methods to investigate academic networks in order to differentiate specific intentions motivating hyperlinking and to evaluate the quality of the linked sites. Park, Barnett, and Nam (2002a, 2002b) studied hyperlink networks in Korea to determine which types of organizations have websites in the most central positions and what factors influence user assessment of website credibility. Barnett and Sung (2005) examined the role that culture plays in the positioning of websites in international networks. A vast number of other applications have been reviewed by Park and Thelwall (2003) and include e-commerce, social movements, interpersonal communication as well as interorganizational and international communication contexts. These studies have established the value of academic inquiry into the formation, structure and meaning of hyperlink networks.

Hyperlinks play an important role in political and collective action communication. Ackland, O’Neil, Bimber, Gibson, and Ward (2006) stress those hyperlinks “help to establish the structure and boundaries of political communication on the web” (p. 4). A hyperlink network serves to connect both members of the NGO issue network and non-members to other members of the network through informal organizing strategies. Members of this interorganizational collective are those NGOs engaged in activities related to an issue (e.g., AIDS, human rights). Hyperlinks provide a powerful way for both members and non-members (e.g., NGOs engaged in another issue, publics) to locate and make sense of the number of NGOs working on an issue. Once an interorganizational hyperlink network is created, non-members interested in an issue as well as members can navigate among organizational members easily. Additionally, search results for hyperlinked organizations are enhanced. For example, Google’s search algorithm uses number of links to establish the rank order, relative importance and validity of websites (Brin & Page, 1998; Henzinger, 2001; Vreeland, 2000).

We argue that the creation of a hyperlink network is best explained by collective action theory (Bimber, Flanigan & Stohl, 2005; Fulk, Flanagan, Kalman, Monge & Ryan, 1996; Olson, 1965). Collective action theory poses that individuals and organizations rationally contribute to public goods which they could not create alone and which are accessible to publics. Examples of traditional public goods include public radio, parks, and union membership (see Hardin, 1982; Knoke, 1990; Olson, 1965). Fulk et al. (1996) and Bimber et al. (2005) extend public goods definitions to include information and computer-mediated public goods respectively. There are two key factors that define public goods, jointness of supply and impossibility of exclusion.
Hyperlink network meet both of these criteria. A hyperlink network is characterized by jointness of supply, since once the hyperlink network is utilized by one individual to search the issue network, the public good is not diminished for others. The hyperlink network is also characterized by the impossibility of exclusion, since as long as individuals have a computer and internet connection, the hyperlink network is accessible to them. The purpose of this study is not to empirically verify that hyperlink networks are a public good, as one would not empirically verify that public radio or a park is a public good. Instead, we examine the rational nature of contributions to this public good and how such contributions are influenced by spatial relationships among NGOs.

Contributions to a hyperlink network involve not only the choice of whether to contribute and the level of that contribution, but also to which other members to link. In other words, a NGO’s choice to hyperlink to other NGOs involves the choice of which other NGOs to link. Additionally, when a NGO chooses to contribute to a hyperlink network, they contribute both the webspace they use to hyperlink to others and the connections that they have to others.

A structural signature is a term used to identify the unique pattern of contributions that is predominant in a network (Contractor, 2006). As such, this study examines the network of relationships among HIV/AIDS NGOs by comparing the observed structural signatures in a hyperlinked network to a distribution of random networks. The purpose of this examination is to determine if the hyperlink network incorporates NGOs within that network in an identifiable pattern. In order to understand these hypotheses, consider the null hypothesis that the NGO hyperlinks occur at random. In this case, some connections between actors with various attributes are likely to occur by chance alone. By chance some NGOs will have more ties to other NGOs and by chance some reciprocal ties among NGOs are likely. However, this research investigates the propensity of structural signatures in the network that occurs beyond what would occur in a network by chance alone. In each of the hypotheses described below, a particular structural signature is hypothesized based upon existing theory and research. While a random network would certainly have some of these structural signatures, in each case the hypothesized relationship is tested against a distribution of random networks to determine if the propensity of this structural signature occurs more frequently or less frequently than would be expected by chance alone.

In Figure 1, three networks with six nodes and six links are visualized. In the first network on the left, the links occur at random. There are some reciprocated links. Some actors receive more ties than others and some actors receive no ties at all. However, all of these links are simply random chance. In contrast, the middle pane demonstrates a network that is characterized by the reciprocity structural signature. There are more reciprocal ties in this idealized network than would occur through chance alone. The final network, displayed in the right pane, demonstrates what a network that is characterized by an actor attribute-based structural signature might look like. In this network, shaded nodes are more likely to receive ties than would
occur by chance alone and non-shaded nodes are less likely to receive ties than would occur by chance alone. While each of these networks represent idealized networks, they demonstrate that various networks may result through the same number of contributions (e.g., 6 links) and the same number of actors contributing (e.g., 6 actors) to the hyperlink network. In other words, each actor's contributions are characterized by to whom they link.

Actor reciprocity
Actor reciprocity denotes a structural signature in which two NGO mutually link to one another. Networks with actor reciprocity have a larger number of reciprocated ties than would be expected by chance alone. Monge and Contractor (2003) argue that reciprocating network relations is best explained by social exchange (Aldrich, 1982) and resource dependency (Pfeffer & Salanick, 1978) theories. In essence, reciprocal ties are evidence that two actors seek mutual benefits by engaging in a relation. In the case of hyperlinks, reciprocal links enhance the recognition of each member of the dyad in search results. Reciprocal links lead publics from one NGO’s website back to a website which recognized the NGO. While reciprocal linking causes the NGO to bear some cost, since many non-reciprocated links can be a measure of relative website authority in some search algorithms (Kleinberg, 1999; Rogers & Marres, 2000), such a relationship must be viewed by the NGOs involved as beneficial if the reciprocity structural signature is more prevalent than by chance alone. Therefore, we hypothesize:

H1: There will be a greater amount of reciprocity among NGOs in the hyperlink network than what would occur by chance alone.
Globalism, globalization and the transformation of spatial relations

One of the purposes of this research is to investigate how spatial relationships impact the structural signatures of hyperlinks among HIV/AIDS NGOs. The relationships among organizations and states around the globe have been the topic of social scientific inquiry for over 50 years. In the 1950s, the realities of differences in the development of different countries and regions around the world became apparent. Arising from this view, modernization theory or developmentalism sought to explain “the process through which a traditional or pretechnological society passes as it is transformed into a society characterized by machine technology, rational and secular attitudes, and highly differentiated social structures” (O’Connell, 1979, p. 13). While modernization theory represents a differentiated set of conceptual models (see Black, 1976 for an overview), two themes unite these models into a perspective. First, most modernization theorists similarly define the characteristics of a modern state. A modern state is democratic, has a pluralistic civic culture, has citizens who participate in their own governance, has an economy developed so much that citizens have leisure time, and has citizens who feel that they can affect change in their government (Almond & Verba, 1963). Traditionally, modernization theories argue that states must develop along a predetermined set of stages in order to become a modern state. For example, Lerner (1958) argued that all states must pass through three stages: urbanization, literacy and developing a participatory media. The emblematic modern state is the United Kingdom (Almond & Verba, 1963).

In response to modernization theory, two critiques developed. The first critique was that of world systems analysis (Wallerstein, 1974). World systems analysis critiqued modernization theory on four bases (Wallerstein, 1996b). First, modernization theory assumed a general pattern of social development, in which third world states would follow the pattern set out by first world states and would end up as clones of first world states in the end. Second, modernization theory ignored the processes that led third world states to their current configuration. Third, modernization theory ignored the history of the entire system or the world, including the influences that states had on one another. Fourth, modernization theory contended that economic, political and sociocultural arenas were independent and therefore the political and sociocultural did not impact economic development directly.

In contrast, world systems analysis (Wallerstein, 1974; 1996a, 1996b, 2000a, 2000b) argued that there were not predetermined steps to development. Instead, there were a set of relationships between states that varied over time, but became stable around 1640 (Wallerstein, 2000a). Core countries had advantages in agricultural capitalism that remained in industrial capitalism. Periphery countries developed weaker state systems and had weaker economies. Semi-periphery countries play a larger political role than economic, ensuring the political position of the core. Wallerstein argues capitalism has operated in the context of a world economy since 1640. In modern information societies, world systems researchers note that the same
system of core, semi-periphery and periphery countries endures with little mobility among the three (Chase-Dunn & Grimes, 1995). For example, Barnett and Salisbury (1996) found that the structure of the modern telecommunication network is consistent with world systems theory. Thus, the logic of capitalism created the world system and continues to stabilize the positions within it.

A second critique of modernization theory arose from globalization researchers (Appadurai, 2001; Castells, 1996; Giddens, 1991; 2000; Held, McGrew, Goldblatt & Perrington, 1999; Huntington, 1996). While modernization theory assumed that the world order and modernity ended with the “modern” states of the 1960s, globalization theorist argued that something new was occurring. Most argued that the end of the cold world created a new era marked by advancing technologies, new organizational forms, shifting responsibilities for nation-states and corporations, and a greater connectedness among people across space and time (Stohl, 2005). These globalization arguments were again critiqued from the perspective of world systems analysis on many grounds including that since 1640 there had been an interdependent global system. However, while world systems analysis provides important critiques of both globalization research and modernization theory, it fails to provide an alternative model. Indeed, Wallerstein (1996b) concedes that world-systems analysis is in a slow decline, in part because it can not provide more than a critique. In sum, he argues “world system analysis is precisely not a theory or a mode of theorizing, but a perspective and a critique of other perspectives” (32). While world systems analysis provides a powerful check to the argument that globalization is transforming spatial relations, it does not offer an alternative. So, while world systems analysis provides an important critique to many of these claims, this research will empirically investigate the claims made by globalization researchers.

The purpose of this research is to investigate globalization researchers’ claim that ICTs have enabled the transformation of spatial relations among NGOs. Case studies including those surrounding the Zapatistas (Castells, 1997; Ronfeldt, Arquilla, Fuller, & Fuller, 1998), the landmine ban movement (Rutherford, 2000) and the anti-deforestation movement (Bendell & Murphy, 2000) have argued that the use of these technologies have led to the transcendence of the north/south divide among NGOs. This research extends these case studies by examining the hyperlink network among NGOs in the global north and global south.

The majority of NGOs are based in Western Europe and North America, excluding Mexico (Boli & Thomas, 1999; Sikkink & Smith, 2002). The divide between northern NGOs and southern NGOs has been discussed extensively over the last decade. Scholars, utilizing resource dependency theories (Pfeffer & Salanick, 1978), have argued that northern NGOs have greater power and access to resources than southern NGOs. This power differential has impacted interorganizational networks of NGOs.

Smith, Pagnucco, and Lopez (1998), in one of the few empirical investigations of interorganizational ties between northern and southern NGOs, found that southern
human rights international NGOs were more concerned with collective interests while northern human rights international NGOs were more concerned with individual rights. Dubash and Oppenheimer (1992) and Ahmad (2006) argue that northern and southern NGOs use distinctive strategies in organizing. Southern NGOs are more likely to concentrate on local and grassroots efforts, while northern NGOs are more likely to focus on national and international policy-making. As such, southern NGOs are less likely to seek to represent coalitions or to form coalitions beyond very local and grassroots organizing. Indeed, Nelson (2002) suggests that northern and southern NGOs have only formed mutual partnerships after considerable pressure from international governance organizations, like the World Bank. Therefore, we hypothesize:

**H2:** Northern NGOs are more likely to hyperlink to other northern NGOs than by chance alone.

![Diagram](N -> N)

**H3:** Southern NGOs are less likely to hyperlink to other southern NGOs than by chance alone.

![Diagram](S !> S)
Table 2 Summary of ERGM results and hypothesis tests

<table>
<thead>
<tr>
<th>Structural Signature</th>
<th>Description of Structural Signature</th>
<th>ML Estimate (SE)</th>
<th>Hypothesis Supported?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arc</td>
<td>The likelihood of one NGO of have a hyperlink tie to another NGO</td>
<td>-3.65 (0.02)</td>
<td>NA</td>
</tr>
<tr>
<td>Reciprocity</td>
<td>The likelihood that two NGOs will hyperlink to each other.</td>
<td>1.92 (0.11)</td>
<td>Yes</td>
</tr>
<tr>
<td>Northern to Northern</td>
<td>The likelihood that a northern NGO will have a hyperlink tie to another northern NGO.</td>
<td>0.17 (0.04)</td>
<td>Yes</td>
</tr>
<tr>
<td>Southern to Southern</td>
<td>The likelihood that a southern NGO will have a hyperlink tie to another southern NGO.</td>
<td>-0.10 (0.03)</td>
<td>Yes</td>
</tr>
<tr>
<td>Northern to Southern</td>
<td>The likelihood that a northern NGO will have a hyperlink tie to a southern NGO.</td>
<td>0.24 (0.03)</td>
<td>Yes</td>
</tr>
<tr>
<td>Southern to Northern</td>
<td>The likelihood that a southern NGO will have a hyperlink tie to a northern NGO.</td>
<td>-0.38 (0.03)</td>
<td>Yes</td>
</tr>
<tr>
<td>Same Region</td>
<td>The likelihood that a NGO will have a hyperlink tie to another NGO in their same region.</td>
<td>0.04 (0.07)</td>
<td>No</td>
</tr>
</tbody>
</table>

H4: Northern NGOs are more likely to hyperlink to southern NGOs than by chance alone.

H5: Southern NGOs are less likely to hyperlink to northern NGOs than by chance alone.

Combined, these hypotheses suggest that contributions to the NGO hyperlink network are more likely to be made by northern NGOs than southern NGOs.

Inter-regional NGO ties
Keck and Sikkink (1998) argue that national and regional differences in networks are important. They contend that such differences are often obscured by the north/south divide debate. Indeed, Shumate, Fulk and Monge (2005) found that common region predicted alliances between HIV/AIDS International NGOs. In similar fashion, we expect that common region may predict the pattern of hyperlink ties among a broader group of HIV/AIDS NGOs. Therefore, we hypothesize that:
H6: NGOs will be more likely to form hyperlinks to other NGOs in their same region than would occur by chance alone

![Diagram](https://example.com/diagram.png)

and

![Diagram](https://example.com/diagram.png)

etc.

Method

Sample
This study utilized a 1-network sampling method (Wasserman & Faust, 1994). First, the authors obtained a list of all organizations from the 2003 volume of the *Yearbook of International Organizations* (Union of International Associations, 2003) whose aims and descriptions included HIV, AIDS or SIDA. This yielded a total of 71 organizations with valid websites (89% had a valid website). Then, two research assistants independently used Google “links to” to identify all the organizations that linked to these 71 HIV/AIDS international NGOs. Each of these websites was examined and all HIV/AIDS related organizational names and websites were recorded. This yielded a total of 248 HIV/AIDS NGO websites. These organizations were located in every region.

Procedures
This research used a combination of webcrawler data and researcher coded data. During the fall of 2005, the researchers used a webbot called SOCSCIbot to crawl the websites of the 248 domains. SOCSCIbot 3 crawls up to 5000 websites per domain and records all hyperlinks (Thelwall, 2004).

In addition to the webcrawler data, three graduate students and the primary investigator recorded the region of each of the 248 HIV/AIDS NGOs. Alta Vista’s Babelfish (AltaVista, 2006) was utilized to translate pages from unfamiliar languages. In cases where such a translation was unsuccessful or the author could not determine the origin of the websites, the data was indicated as missing (n = 3).

Measures

Region
Utilizing the coding scheme established by Smith (1997), eight regions were recorded. These were Africa, Asia, Middle East, Australia/N. Zealand/Pacific Islands, Europe (West), Europe (East), North America (excluding Mexico), South
and Central America, Mexico, and the Caribbean. The sample was unevenly distrib-
uted across these regions. There were more HIV/AIDS NGOs in the sample located
in North America \((n = 89, 35.9\%)\) and Western Europe \((n = 78, 31.5\%)\), than in
Africa \((n = 25, 10.1\%)\), Asia \((n = 10, 4.0\%)\), the Middle East \((n = 3, 1.2\%)\), Australia/
N. Zealand, Pacific Islands \((n = 15, 6.0\%)\), Eastern Europe \((n = 8, 3.2\%)\), and South
and Central America, Mexico, and the Caribbean \((n = 17, 6.9\%)\). There were 3
\((1.2\%)\) HIV/AIDS NGOs for whom region could not be identified. This data was
recorded as missing.

Northern/Southern NGOs
Northern NGOs were identified as HIV/AIDS NGOs headquartered in North Amer-
ica (excluding Mexico), Western Europe and Australia/N. Zealand, Pacific Islands.
Southern NGOs were identified as HIV/AIDS NGOs headquartered in any other
region. As expected based upon previous research (Sikkink & Smith, 2002), there
were more northern NGOs \((n = 182, 73.4\%)\) than southern NGOs \((n = 63, 25.4\%)\).

Analysis
First, descriptive statistics were created to provide an overview of the data. These
descriptive statistics included the indegree centrality distribution, or the distribution
of the number of hyperlinks received by each NGO, and the outdegree centrality
distribution, or the distribution of the number of hyperlinks from each NGO. Additonally, the density, or the ratio of observed hyperlinks to possible hyperlinks
(i.e. the number of hyperlinks that would result if every website in the sample were
connected to every other website in the sample), is reported.

In order to test the hypotheses, this study used Exponential Random Graph
Modeling using Monte Carlo Maximum Likelihood Estimates (Robins, Pattison,
Kalish, & Lusher, 2007). This method, like Pseudo-likelihood p* modeling (Con-
tractor, Wasserman & Faust, 2006; Monge & Contractor, 2003; Palazzolo, 2005),
examines the probability of certain structural signatures, or subgraphs, within the
larger network. The basis of the analysis is to determine if the structural signatures
occur more often than by chance alone by simulating a distribution of random
networks of the same size as the observed network. Then the prevalence of the
hypothesized structural signature observed is compared to the distribution of the
hypothesized structural signatures of the simulated networks. Like in multiple
regression analysis, multiple structural signatures can be estimated simultaneously
and shared variance can be removed. The benefit of this technique is that it most
closely suits the interdependency of network observations and has been shown to
produce more reliable estimates than Pseudo-likelihood p* modeling. We used
PNET (Wang, Robins, & Pattison, 2006) to perform this analysis.

For the purposes of hypothesis testing, we created an exponential random graph
model that included all the hypothesized structural signatures and the arc structural
signature. The arc structural signature examines the probability that an actor will link
to another actor. In sparse networks, the arc structural signature is used as a control
variable for the sparsity of network ties. The model was estimated until all the parameters converged, indicated by a \( t \) value of less than 0.1 for each parameter (Snijders, Pattison, Robins & Handcock, 2006). In this application, the \( t \)-statistic is equivalent to:

\[
t = \frac{\text{observed mean} - \text{sample mean}}{\text{standard deviation}}
\]

For hypotheses 1, 2, 4 and 6, the hypothesis was supported if the maximum likelihood was positive and greater than twice the magnitude of the standard error. The distribution of these network statistics is unknown. Network statistics, unlike parametric statistics, are not generally normally distributed and are not independent. However, as a guide for researchers who may not be familiar with these statistical techniques, it may be helpful to consider that if the network statistics were normally distributed, an estimate that was twice the magnitude of the standard error would approximate \( p < 0.05 \) (see Snijders et al., 2006). For hypotheses 3 and 5, the hypothesis was supported if the maximum likelihood estimate was negative and greater than twice the magnitude of the standard error.

**Results**

This research examines both the distribution of contributions and the prevalence of structural signatures within the hyperlink network. First, descriptive statistical analysis about indegree and outdegree centrality of hyperlinks was conducted (see table 1). The average indegree and outdegree centrality for an in the network was 6.61. The average indegree centrality for northern NGOs was 7.67, while the average indegree centrality for southern NGOs was 3.41. The average outdegree centrality for northern NGOs was 6.89 and the average outdegree centrality for a southern NGO was 5.71. Figure 2 displays the distribution of indegree and outdegree centrality.

![Figure 2 Indegree and outdegree centrality distribution of HIV/AIDS NGO websites hyperlinks](image-url)
scores for the NGOs in the network. As can be seen in the figure, the distribution of both indegree and outdegree centrality resembled a reverse-J shaped distribution. Few NGOs reported a high number of hyperlink ties to other NGOs or from other NGOs in the sample. The overall density of the network was 0.027, indicating a sparse network of ties among the websites in comparison to the potential number of hyperlinks that could be present. Variations among NGOs are examined during hypothesis testing.

Hypothesis 1 stated that there would be a greater number of reciprocal ties among NGOs in the hyperlink network than would be expected by chance alone. This hypothesis was supported \((ML Estimate = 1.92, SE = 0.11)\). This means that the HIV/AIDS hyperlink network was characterized by the reciprocity structural signature.

Hypotheses 2 through 5 addressed the structural signatures of contributions among northern and southern NGOs. Hypothesis 2 stated that northern NGOs would be more likely to link to other northern NGOs than by chance alone. This hypothesis was supported \((ML Estimate = 0.17, SE = 0.04)\). Hypothesis 3 stated that southern NGOs would be less likely to link to other southern NGOs than by chance alone. This hypothesis was supported \((ML Estimate = -0.10, SE = 0.03)\). Hypothesis 4 stated that northern NGOs would be more likely to hyperlink to southern NGOs than by chance alone. This hypothesis was also supported \((ML Estimate = 0.24, SE = 0.03)\). Finally, hypothesis 5 stated that southern NGOs would be less likely to hyperlink to northern NGOs than by chance alone and that Southern NGOs were less likely to hyperlink to other NGOs than by chance alone.

Hypothesis 6 stated that NGOs would be more likely to hyperlink to other NGOs in their same region than would occur by chance alone. This hypothesis was not supported \((ML Estimate = 0.04, SE = 0.07)\). This means that NGOs were not more likely to have hyperlinks within the same region than would occur by chance alone taking into account the other factors within the model.

**Discussion**

The purpose of this research is to explore structural signatures within the NGO hyperlink network. The outdegree centrality distribution indicated that levels of contribution to the hyperlink network (i.e. inclusion of hyperlinks to other NGOs) varied. Additionally, the indegree centrality distributions revealed that a few organizations received a large number of hyperlinks and most organizations received very few hyperlinks. Upon examining the structural signatures within the hyperlink network, three results emerged. First, we found that the reciprocity structural signature occurred more frequently than would be expected by chance alone. Additionally, we found that northern NGOs contributed more to the hyperlink network than would be expected by chance alone and that southern NGOs contributed less to the hyperlink...
network than would be expected by chance alone. Finally, we failed to find support for the within region structural signature. Each of these results is discussed in turn.

First, this research found that the NGO hyperlink network had more reciprocal ties than were likely to occur by chance alone. Monge and Contractor (2003) argue that reciprocal relationships are evidence that resource/social exchange influence the pattern of relationships. This means that NGOs are aware of which organizations hyperlink to them and are more likely than by chance to reciprocate. Such reciprocity supports the argument that to hyperlink is a strategic communication choice (Jackson, 1997).

Additionally, these results demonstrate that, despite the enthusiasm of some globalization researchers (for example see Castells, 1997; Juris, 2004; Rutherford, 2000), hyperlink networks are shaped by the north/south divide. Similar to work done by Boli and Thomas (1999), Smith (1997) and Castells (1997), we found the majority of HIV/AIDS NGOs in our sample were from the global north. Additionally, we found that these NGOs were more likely than by chance alone to form ties with other NGOs from the global north. Drawing from Rogers and Marres (2000), we note that such a pattern reinforces the legitimacy of northern NGOs, drawing these NGOs toward the center of the issue network. In contrast, southern NGOs were less likely than by chance alone to link to other southern NGOs. Furthermore, northern NGOs were more likely than by chance alone to link to southern NGOs, although the tendency was reversed from southern to northern NGOs. Consistent with Smith, Pagnucco, and Lopez (1998), this research finds that northern NGOs are more likely to link to NGOs internationally.

Results indicating that northern NGOs were more likely than by chance alone to contribute to the hyperlink network and that southern NGOs were less likely than by chance alone to contribute to the hyperlink network support Dubash and Oppenheimer’s (1992) and Ahmad’s (2006) argument that northern and southern NGOs have distinctive strategies. In general, they argue that southern NGOs are more likely to concentrate on local and grassroots efforts, while northern NGOs are more likely to focus on national and international policy-making. As such, southern NGOs are less likely to seek to represent coalitions. Specifically, southern NGOs were less likely to form relationships beyond those with very local and grassroots NGOs, unlikely to be represented in hyperlinks. In contrast, northern NGOs are more actively seeking to create a hyperlink network that raises the visibility of their issue to national and international policy makers. Thus, there may be greater incentives for northern NGOs to make investments in a hyperlink network, while southern NGOs may not be motivated by similar incentives. The prevalence of language differences, education level, resource level and cultural differences are alternatives that may also contribute to differences in hyperlinking behavior in the global south and global north (Barnett & Sung, 2006).

Finally, while we included region as one measure of the complexity that might exist beyond the north/south divide, as argued by Keck and Sikkink (1998), we found that the north/south divide played the most significant role. There was not support
for the hypothesis that there would be a relationship between hyperlinking and being in the same region. These findings are contrary to those of Shumate, Fulk and Monge’s (2005) study of alliances among HIV/AIDS NGOs. We believe there are at least three possible explanations for the lack of support for this hypothesis. First, Shumate, Fulk and Monge examined formal alliances between organizations while we examined hyperlinks. Hyperlinks do not denote formal cooperative relationships. As such, these ties may be governed by different theoretical mechanisms. Second, Shumate, Fulk and Monge utilized a different network analysis technique which may yield different results. They used multiple regression quadratic assignment procedure to examine the relationships between attributes and networks, while this study used exponential random graph modeling. As they acknowledge in their paper, multiple regression quadratic assignment procedure is less than ideal, and we fulfill their call for future research to use more advanced network methods as they have become available. Finally, Shumate, Fulk and Monge did not consider the north/south divide in their research. It may be that the north/south divide also plays an important role in formal alliances, but that is beyond the scope of the current research.

Implications

This research sought to test the assertion that ICTs are breaking down the global north/south divide. We argued that hyperlink networks are a public good and that contributing to the hyperlink network is a form of collective action that is marked by structural signatures. The results of this research suggest that contributions to the hyperlink network reflect a) strategic choice in which participants are aware of whom hyperlinks to them and b) a tendency for the global north contribute to the hyperlink network more than the global south.

When considering the problem of global AIDS (Patton, 2002; UNAIDS, 2006), the pattern of relationships online between HIV/AIDS NGOs is disconcerting. AIDS is a global problem that crosses borders and whose impact in the global south is especially acute. Relationships among NGOs, indicated in part by hyperlink relationships, represent one organizational structure that may be part of a larger solution including the participation of businesses, governments and social institutions. If northern NGOs, as suggested by Dubash and Oppenheimer’s (1992) and Ahmad (2006), are primarily concerned with framing the problem and advancing policy solutions, then southern NGOs failure to contribute to a public good with these NGOs is troublesome. As Justice (1987) showed, policymaking by donor agencies and international health coalitions that does not have substantial input from recipients can lead to poor implementation outcomes. So, this leads us to consider the question, why are there more likely to be ties from NGOs in the global north to the global south than by chance alone but not visa versa?

There are at least two competing explanations. First, modernization theory would suggest that southern NGOs are part of a less developed civic culture (Almond & Verba, 1963). As such, they are less likely to participate in collective actions
because these organizations have not developed to the extent where such action would be valued. Given enough time, resources, and support from northern NGOs, southern NGOs will “catch-up”.

But as with modernization theory’s broader claims, world systems analysis (Wallerstein, 1974; 1996a) seems to suggest that this is a short-sighted view. The current divides that exist between northern and southern NGOs have historical causes. Southern HIV/AIDS NGOs have not always been treated as partners by northern NGOs. For example, in the 1990s many northern HIV/AIDS NGOs attempted to form the International Coalition of AIDS Service Organizations with the assumed participation and without the consent of the African AIDS service organizations (Gorenker, Coate, Jönsson & Söderholm, 1995; Shumate, Fulk & Monge, 2005). Until 2003, the largest funding for African AIDS programs came from the United States Agency for International Developments and the Bill and Melinda Gates Foundation (Berry, 2007), instead of multilateral organizations or local agencies. This funding arrangement is another indicator of such dependence. Thus, historical dependencies may explain why southern NGOs do not hyperlink to either the northern NGO who hyperlink to them or to one another.

Some researchers have suggested that the good cause, sheer will and lowering costs of ICTs will make northern and southern NGO collective action more likely (for example see Bray, 2000). However, such technologies do little to overcome historical divides. As long a system of dependency exists between those in the global north and those in the global south, which according to world systems analysis is the inevitable consequence of capitalism (Wallerstein, 2000a), a divide between northern and southern NGOs is likely despite technological innovations. As long as the divide exists, it is the responsibility of northern NGOs to seek to understand and incorporate views from the perspective of those in the global south when influencing public policy.

Limitations and Future Research
Four limitations must be acknowledged in this study. First, the websites that were examined were all from organizations concerned with HIV/AIDS. It can be theorized, but not known, that the hyperlink networks of organizations involved in other issues would display the same tendencies. Future research should investigate the hyperlink networks focusing on other social issues. Second additional factors such as NGO size, scope of activity, dominant language and resources may provide possible explanations for the global network. Future research should examine these possibilities. Third, this research uses a 1-network sampling strategy (Wasserman & Faust, 1994) to determine which NGOs to include in the network starting from a sample of HIV/AIDS international NGOs. A 1-network sampling strategy takes a core network and then includes all nodes that are linked to the nodes within the core network in the sample. Other sampling strategies may have yielded different results. Future research should compare these results with networks gathered through alternative methods. Finally consistent with previous research on NGOs
(Boli & Thomas, 1999; Smith, 1997), we categorized NGOs based upon the region in which they are headquartered. However, as noted both by Keck and Sikkink (1998) and some scholars engaging in world systems analysis (see Chase-Dunn & Hall, 1997 for a discussion), national differences within world region may play an even more important role. Additionally, the location of NGOs in global cities verses less urban environments may play an additional role in the network configuration of NGOs (see Knox, 1995; Sassen, 2001). Future research should examine these alternatives.

Finally, Nelson (2002) contends that cooperation between northern and southern NGOs is unlikely without pressure from intergovernmental organizations, like the World Bank or UNAIDS. As such, it is up to governmental organizations to regulate the practices of NGOs in order to reap the benefits of these transnational networks. Future research should investigate the role that intergovernmental organizations play in hyperlink networks.

Conclusion

The purpose of this research was to explore the structural signatures of contributions to NGO hyperlink networks. This research made two contributions to the literature. First, this research confirms some of the results of previous case study research on the north/south divide. Second, this research challenges the globalization hypothesis that ICTs are eliminating the north/south divide. Instead, we demonstrate that hyperlink behavior reinforces some of the same tendencies that existed before the advent and cost reduction of internet technologies.

This research examines one type of interorganizational communication relationship. This research implies that interorganizational communication is shaped by both the desire to improve the visibility of issue networks and the influences of NGO location. Although many issues are of great concern on a global scale, the collective action to bring awareness, service, and policy change concerning these issues is shaped by historical global divides. This finding should be of concern to both academics and policy-makers.

This research has affirmed the vast and troubling discrepancy between northern and southern HIV/AIDS NGOs. It goes without saying that the regions most devastated by this pandemic have the least internal resources deal with it. It is important that academic inquiry examines these social inequities and provides validation for future programs and policies.

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Notes

1 We acknowledge that internet access is not available to all NGOs. See Wilson (2004) for a discussion of the global digital divide.
2 Rogers and Marres (2000) note that the context of hyperlinks influences their meaning. For example, some blogs link to other blogs with which they disagree. However, due to the context of HIV/AIDS NGO websites, hyperlinks are viewed as a positive, legitimacy creating recognition.
3 Structural signature is a new term that is currently being used among social network analysis scholars to describe the unique patterns prevalent in the network. Previous terms include network parameters (Monge & Contractor, 2003) and network structures (Palazzolo, 2005). While the term is used to describe these unique patterns, the meaning here is synonymous with other terms.
4 Non-reciprocated links enhance the authority weight in Kleinberg’s (1999)’s algorithm relative to others in the community by not contributing to other websites’ authority weight. A website that is linked to by many hubs (defined as a website that links to many authorities), is an authority. If authority “A” links to other authorities “B” and “C”, it contributes its hub weight to the authority weight of “B” and “C”. Thus, everyone benefits by increasing their authority weight. In contrast, if the links from “A” to “B” and “A” to “C” are non-reciprocals, then “B” and “C” will gain higher authority weights than “A”, because “A”’s hub weight will increase “B” and “C”’s authority weight but not visa versa. Thus, those websites who do not reciprocate links may receive some relative benefit in search results that they would lose by reciprocating the links.

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