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Structural Position and Perceived Similarity*

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Several alternative models of structural similarity, or positions, have been proposed. A wide variety of algorithms currently are employed to detect structural positions in a social network. The present work explores how these models correspond to the perception of interpersonal similarity. At the same time this work helps to explain how social structure may influence perceptions. Social network data were collected over 11 weeks in a class of 18 college students. Positional similarities in the network based on structural equivalence, automorphic equivalence, and regular equivalence were compared with ratings of perceived similarity at the end of the semester. Positions in different types of relationships were compared. Results suggest that perception of similarity is related more closely to abstract notions of position, or general equivalences in a network, than to specific positions based on structural equivalence. Implications for perceived similarity in relations with some imposed structure are discussed.

Two types of structures in social networks have received the most attention from social scientists; cohesive subgroups and structural positions. Intuitively, a cohesive subgroup in a network is a set of people who "hang around together." Two people are thought to belong to the same subgroup if they are somehow close to each other. The attention to cohesive subgroup structures is not limited to scientific analyses; Freeman, Freeman, and Michaelson (1988) demonstrate that people are quite aware of subgroup structures in their community. They report a remarkable correspondence between the combined perceptions of subgroup structure and the observed interaction patterns ($r = .97$). That is, the more often two people are seen talking together, the more likely they are to be regarded as belonging to the same subgroup.

Scholars have proposed a wide variety of formal definitions of cohesive subgroups and measures of cohesiveness (for review see Freeman forthcoming a; Wasserman and Faust 1992, ch. 7). Freeman (forthcoming b), however, argues persuasively that people expect transitivity in cohesive relations. For example, if a person observes Mary interacting with Joe a lot and Joe interacting with Dave a little, the observer will assume that Mary and Dave interact with each other at least a little. Freeman explains that this is the logic underlying single-link hierarchical clustering and that clusters found with this algorithm represent correctly people's perceptions of cohesive subgroups. Thus it has been demonstrated that people's perceptions of subgroups are based largely on observations of interaction, and the appropriate model of perceptions of cohesiveness has been identified.

In contrast to proximity-based cohesive subgroups, positions refer to *similarity* among actors in a network based on their pattern of ties with other actors. Intuitively, two people occupy the same position if their patterns of interaction are the same. Structurally, similar actors are thought to be similar "types" and to play similar social roles.

As with cohesive subgroups, scholars have developed an impressive array of measures of positional similarity and methods for identifying positions (for reviews and comparisons see Doreian 1988; Faust 1988; Pattison 1988; Wasserman and Faust, ch. 9). All of these positional methods purport to identify sets of individuals who are similar or to measure the degree of structural similarity among individuals. Similarity, in the structural sense, refers to the degree to which actors have the same types of ties with the same types of others. Positional methods can identify formal positions, or statuses, in which interactions are formally prescribed and labeled, as in organi-

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zational hierarchies. Yet, positional methods also can identify *informal* positions. Informal positions can be identified in any setting based on voluntary social relations. In a set of people who work together, for instance, the informal social network might be defined by the relations of eating lunch together and eating dinner together. Thus two people who eat only lunch with other co-workers would be considered more similar to each other than to another co-worker who eats dinner as well as lunch with co-workers.

Although structural analysts can define and identify informal positions in a social network, the degree to which individuals in the community "see" these positions is unknown. Boster, Johnson, and Weller (1987) found that perceptions of interpersonal similarity were correlated highly with labeled statuses in a hierarchically structured group ($r = .73$ and $.78$). The relationship between individuals' perceptions of similarity and their patterns of social relationships in informal groups has not been examined, however. Therefore it is unclear which model of positions in social networks most accurately reflects individuals' perceptions of social similarities. Moreover, it is not known whether patterns of social relations have any influence at all on perceptions of similarity, much less which patterns might have the strongest effect on perceptions.

Accordingly we designed the current research to examine the relationship between patterns of social relationships and perceptions of similarities in a community with no formal positions. We did so with two purposes in mind. The first is to establish whether patterns of social relations might contribute to people's perceptions of interpersonal similarity. The second is to examine which social network model of position corresponds most closely to how people perceive similarities among others around them. Below we consider two basic structural models of positions as possible representations of social similarities or roles.

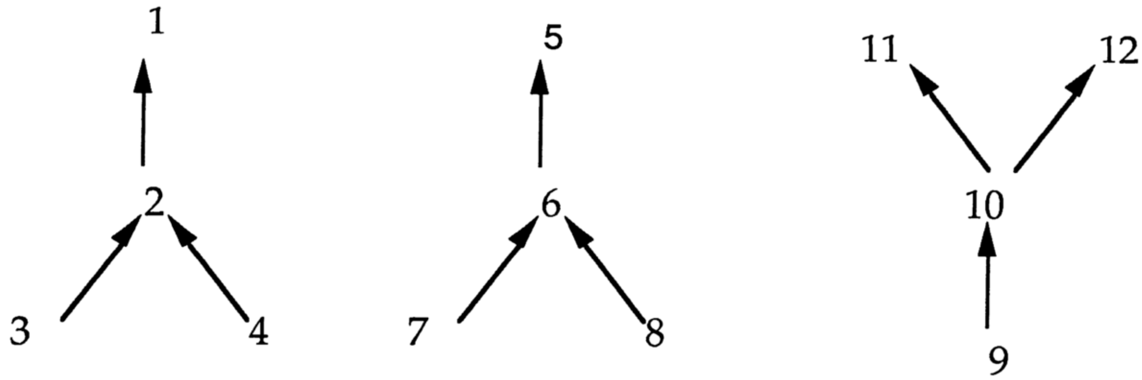
Models of Position

Structural equivalence. Two basic conceptualizations have emerged as competing models of positions in social networks: structural equivalence and general equivalence (Faust 1988). Lorrain and White (1971) were the first to offer a mathematical model of positions in social networks with their definition of structural equivalence using category theory. "Objects a, b of a category C are structurally equivalent if, for any morphism M and any object x of C, aMx if and only if bMx, and xMa if and only if xMb" (p. 63). In other words, two people occupy the same position when they have identical social ties to and from the same other people in the network. Figure 1 represents relational ties of one type in a set of 12 actors. Actors 11 and 12 are structurally equivalent to each other because both are chosen by Actor 10. Similarly, Actors 3 and 4 are structurally equivalent to each other and Actors 7 and 8 are structurally equivalent to each other because the set of structurally equivalent actors chooses the same other (2 and 6 respectively).

Typically, two actors' ties to each other are ignored when their structural equivalence is assessed. That is, researchers employing a structural equivalence model of position do not impose any requirements about cohesion. Notice, however, that if two nonisolated actors are structurally equivalent, at most there is one intermediary between them. Thus, as Borgatti and Everett (forthcoming) argue, a structural equivalence model of position is confounded with cohesion (see White and Reitz 1983).

General equivalence. Some researchers have found structural equivalence too strict to capture the intuitive notions of position. This situation led to proposals of general equivalence models of positions that do not require actors to have ties to the *same* others (Borgatti, Boyd, and Everett 1989; Burt 1990; Everett 1985; Sailer 1978; White and Reitz 1983; Winship 1988; Winship and Mandel 1983; Pattison 1988; for review see Wasserman and Faust 1992). Rather, all definitions of general equivalences insist only that actors have the same ties to *similar* others. In a friendship network, for instance, one might consider that a person who is friends with others who in turn have no other friends occupies a different position from a person who is friends with others who do have other friends. The relaxation from structural equivalence to general equivalence definitions of position allows two teachers to occupy the same position even if they have no students in common, as long as they both have students. General equivalence models vary, however, in how they define "similar."

Two commonly used general equivalences, automorphic equivalence and regular equivalence, offer slightly different formalizations of position. Both definitions are recursive in



Sets of structurally equivalent actors:

{3, 4}
{7, 8}
{11, 12}

Sets of automorphically equivalent actors:

{1,5}
{2, 6}
{11, 12}
{3, 4, 7, 8}

Sets of regularly equivalent actors:

{1, 5, 11, 12}
{2, 6, 10}
{3, 4, 7, 8, 9}

Figure 1. Examples of Positional Models in a Graph of One Relation among 12 Actors, with sets of Equivalent Actors Enclosed in Brackets

that two actors are equivalent when they have similar ties to equivalent others. Simply put, two actors are *automorphically equivalent* if they are completely indistinguishable in a graph of the network, with actors' labels removed (for more technical discussion see Everett 1985; Winship 1988; Winship and Mandel 1983). In Figure 1, Actors 1 and 5 are automorphically equivalent because both are chosen by one other actor, each of whom is chosen by two other actors. Actors 3, 4, 7, and 8 all are automorphically equivalent to one another because each chooses one other actor, who in turn chooses one other actor.

Two actors are *regularly equivalent* if for each tie that one actor has, the other has the same type of tie with at least one other who is regularly equivalent (for more technical discussions see Borgatti and Everett 1989, forthcoming; White and Reitz 1983). Figure 1 illustrates three sets of regularly equivalent actors. Actors 3, 4, 7, 8, and 9 all choose at least one other actor, who in turn chooses at least one other. Actors 2, 6, and 10 are chosen and in turn choose another or others. Finally, Actors 1, 5, 11, and 12 each are chosen but do not choose another.

The fundamental difference between these two general equivalences is that automorphic equivalence is sensitive to the number of ties each actor has (degree), whereas regular equivalence is not. For instance, a teacher with one student can be regularly equivalent, but not automorphically equivalent, to a teacher with 10 students. Thus in general, automorphic equivalence provides more distinction among actors than does regular equivalence (Everett 1985).

Comparisons. Structural equivalence is a special case of automorphic equivalence, and automorphic equivalence is a special case of regular equivalence (Borgatti and Everett 1989; White and Reitz 1983). Therefore, if two people are structurally equivalent, they necessarily are automorphically equivalent. Similarly, if two people are automorphically equivalent, they necessarily are regularly equivalent. Positions identified with automorphic equivalence and with regular equivalence are progressively more abstract than positions identified with structural equivalence.

Whereas structural equivalence positions "tend to include individuals who are closely connected to one another or to the same other(s)" (Faust 1988, p. 337), general equivalence-based positions are not restricted to including cohesion as well as similarity. Although social scientists are coming to agree that general equivalences reflect their notions of position more closely, questions remain about the perceptions of actors in a network.

The following questions are the specific focus of the current study. Do people perceive as similar others who are in generally equivalent positions? Or must people be tied to the *same* alters in order to be perceived as similar? Further, if general equivalence is the proper model of perceptions of similarity, are people sensitive to the number of ties people have, or only to the types of ties?

Both structural and general equivalences are ideal models of positions. In fact, people rarely occupy identical positions; therefore measures of positional similarity have been proposed based on each of the ideal models of position. In the next section we describe the most commonly used measures of positional similarity. After that we describe social relations and perceived similarities among students in a classroom so that correspondences between positional similarities and perceived similarity can be examined.

METHODS

Measures of Positional Similarity

Based on structural equivalence. There are two common measures of the degree to which two actors are structurally equivalent. Each actor's location in a network is represented by the rows and columns corresponding to that actor in each relational matrix in the network. Stringing out the rows and columns results in location vectors containing information about an actor's ties to and from all others on all relations in the network. Both Euclidean distance (Burt 1976) and Pearson's correlation coefficient between two actors' location vectors are used as measures of positional similarity. Pearson's correlation coefficient is the first step in the CONCOR blocking algorithm, and is consistent with its logic (Breiger, Boorman and Arabie 1975; Faust 1988). Both of these measures reflect the degree to which two actors have similar ties with the *same* others, and thus measure the degree to which those actors occupy structurally equivalent positions.

The difference between Euclidean distance and Pearson's r is evident when relations are valued. Pearson's r is insensitive to differences in scale; it measures similarity in pattern of ties to and from the same others. Euclidean distance retains differences in scales; it measures absolute identity between location vectors (for a discussion of these points see Burt 1986; Faust and Romney 1985, 1986). In addition, Pearson's correlation is a similarity measure and Euclidean distance is a distance measure, so typically they are correlated negatively with one another. Furthermore, Pearson's r ranges from -1 to $+1$, whereas Euclidean distance theoretically ranges from 0 to infinity.

Based on automorphic equivalence. The recursive definitions of general equivalences make their measurement more complicated. A measure of first-order approximation to automorphic equivalence with valued relations was proposed by S. Borgatti (Freeman and MacEvoy 1988). The algorithm, MAXCORR, compares modified location vectors of each member of a pair of actors. Essentially, an actor's location vector first is modified by ranking his or her ties to others and from others for each relation separately. Then the coefficient of identity (Zegers and tenBerge 1985) is calculated as a measure of association between two actors' modified location vectors; this measure indicates their degree of automorphic equivalence, ranging from 0 to 1.

Based on regular equivalence. The degree to which two actors are regularly equivalent usually is calculated with an algorithm, REGE, developed by White and Reitz (1985). REGE is an iterative algorithm that measures the degree to which each of one actor's ties can be matched by another actor's equivalent tie to a similar other (see Freeman and MacEvoy 1988 for a detailed discussion). Typically the algorithm is run for three iterations; the resulting measures of regular equivalence range from 0 to 1.

All four of these measures of positional similarity can be calculated on the basis of many relations in a network (Doreian 1988 and Faust 1988 compare results from some of these algorithms). The relations can be binary or valued, although the measures are more informative if they are calculated on the basis of valued relations. In addition, these four measures of positional similarities can be based on actors' ties to and from all others. All of the algorithms can be found in the UCINET network analysis package (Freeman and MacEvoy 1988). In the next section we describe the data with which perceptions of similarities are compared to structural positions on the basis of structural and general equivalences.

Data Collection

The setting. We studied positional similarity and perceptions of similarity in an undergraduate speech communication course of 18 students (seven males, 11 females) at the University of Illinois. 32 students were enrolled at the start of the semester. By the end of the first week, however, 13 students had dropped out for various reasons unrelated to the study, and another student attended only one more time. These 14 students were not included in the study. Participation in the study was voluntary and confidential, and had no effect on course grades. The class met for one hour three times a week, for 14 weeks. None of the students knew each other at the beginning of the semester, except for a pair of females who had met each other.

Typically the class was conducted as a discussion session; often the students sat in a circle. Therefore it is not unreasonable to expect that an informal social structure developed. In fact, some of the students attended informal "happy hours" together at a local bar. Two types of data were collected in this classroom: similarity ratings indicating perceptions and relational data from which positional similarities could be calculated.

Perceptions of similarity. During the last week of class, after the students had had a chance to observe each other's interaction patterns over the entire semester, they were given a roster of dyads pairing all class members (153 dyads). They were asked to rate, on a scale from 1 to 7, the degree to which they perceived the members of each pair of students in the class to be similar to one another. Two of the 18 class members were absent on this day and did not respond. Each respondent received a different random ordering of the pairs.

The primary aim of the research was to identify the model of positions most strongly associated with perceptions of similarity. Therefore the questionnaire began with the following discussion, asking the students to focus on similarity rather than on cohesion:

> People tend to categorize other people. Sometimes people categorize each other according to social groups (i.e. who is friends with whom and who hangs out with whom). In this project, however, we are interested in how people categorize others based on similarities rather than on friendships. For instance, people think of one another as being particular "social types" or of playing particular "social roles" in a situation. And, people who are perceived to be similar are considered to be similar social types or occupying similar social roles.
>
> We would like to know how similarly you perceive the people in the class (including yourself) based on social types or social roles. So, the next several pages contain a list of pairs of people with a scale from 1 to 7 following each pair. For every pair, please circle the number that indicates the degree of similarity of the two people. The scale ranges from 1, indicating very dissimilar, to 7, indicating very similar, with 4 meaning that the two people are neither similar nor dissimilar. Thanks.

This rating task appeared to be easy for the students. Each of the 16 respondents rated all 153 pairs of class members in less than one half-hour with no problem.

Although judging the similarity of their classmates seemed to come naturally to the respondents, their responses show quite a bit of variation. Correlations between any two respondents' judgments of similarity range from .069 to .714. In addition, the first factor of the correlation matrix, using minimum residual factor analysis, accounts for at least 7.11 times more of the variance in agreement among judges than does any other factor. All first-factor scores are nonnegative. This finding suggests that knowledge about social types or roles is distributed among the class members as is any other type of cultural knowledge, conforming to the consensus model (see Boster et al. 1987; Romney, Weller, and Batchelder 1986). Furthermore, students had differential access to information about their classmates based on class attendance and on participation in extracurricular social activities. To reduce the effects of variation in social knowledge and in access to information, we averaged the ratings received by each pair of class members over the 16 judges. Thus the mean rating received by a pair of class members reflects the overall degree to which they were perceived as similar.

Positional similarity. The social structure of the class members was determined through responses to a sociometric questionnaire administered each week of the semester except the first and the last (11 questionnaires). The questionnaire listed each of the class members and asked respondents whether, in the past week, they had interacted with each of the other students in class, socially, or both. These data are self-reports and thus are prone to error (see, for example, Bernard, Killworth, and Sailer 1980, 1982).

However, Freeman, Romney, and Freeman's (1987; Freeman and Romney 1987) reanalysis of Bernard et al.'s studies of informants' accuracy suggests that errors in recall are biased toward long-term social structure. Our present research depends on the degree to which each pair of class members interacted over time rather than on the accuracy of reports of one instance. Therefore the cumulation of individual reports over all weeks is taken as an indication of the long-range structure of interaction in class and socially. This procedure resulted in two 18 × 18 relational matrices indicating degree of interaction in class and degree of interaction socially. For instance, the (i,j) entry in the social interaction matrix is the proportion of times the *i*th person responded to the questionnaire in which he or she reported social interaction with person j.

The classroom setting presents one minor complication: not all interaction in class was entirely voluntary. Occasionally the class was divided into groups for class exercises, and these imposed interactions might have obscured some of the structure that influences perceptions of similarity. Presumably students can discern when positive or negative affect is involved in the interactions they observe. Thus students' positions in the affect structure of the class might influence how similarly they are perceived. Yet if only interaction data are collected in class, some of that affect structure would be ignored in calculating positional similarities.

To access the affect structure based both on initial impressions and on the emerging friendships, each week we also asked the students whether they thought they would enjoy working with each of the other class members, regardless of whether they knew them. The affect question was phrased in this way with the expectation that the students would be more comfortable in reporting affect in a class-related context than in a general context of friendship, especially at the beginning of the semester. They were allowed to answer "yes," "no," or "don't know." Again we cumulated the responses over the 11 weeks of questionnaires and created two more relational matrices: positive affect and negative affect.

Table 1 displays correlations among the four relationships. Because the correlations are interrelated, we calculated significance levels using Bonferroni's method for multiple comparisons (as described in Neter, Wasserman, and Kutner 1990). The correlations are not very large: they range from 0.361 (between positive and negative affect) to .097 (between negative affect and social interac-

Table 1. Pearson's Correlation Coefficients among Relations.

	Negative Affect	Class Interaction	Social Interaction
Positive Affect ($\bar{X}$ = .53, sd = .24)	−.36**	.28*	.11
Negative Affect ($\bar{X}$ = .06, sd = .11)	—	−.17	−.10
Class Interaction ($\bar{X}$ = .30, sd = .20)	—	—	.24*
Social Interaction ($\bar{X}$ = .08, sd = .12)	—	—	

Note: Significance levels were computed using Bonferroni's method for multiple comparisons.
* Overall p <.05.
** Overall p <.01.
N = 153
z-scores were calculated using nonparametric permutation tests because of the nonindependence of the cases. The magnitudes of the z-scores are comparable to the Pearson's correlation coefficients and are not reported.

tion). Each of the relational questions seems to measure different relations. Thus the social network in the classroom consists of three different types of relations: interaction in class, social interaction, and affect, with affect indicated by two relational matrices.

Measures of positional similarity in the social network were computed on the basis of the rows and columns of these four valued relational matrices. Structural equivalence in the classroom was measured by Euclidean distance and Pearson's correlation coefficient. Automorphic equivalence was measured with the MAXCORR algorithm, and regular equivalence was measured with the REGE algorithm.

Two types of data are used in this study to examine the relationship between positional and perceived similarities. The first type is measures of positional similarities: the two alternative conceptualizations of positional similarity are measured by two methods each in the network of four social relations. The second type of data is the overall perception of similarity among pairs of class members after the students had a semester to develop their perceptions of each other.

RESULTS

General Equivalences as Models of Perception of Similarity

Associations among the four positional measures and the overall similarity ratings are reported as a correlation matrix in Table 2. Pearson's correlation coefficients were calculated among the five variables over all 153 dyads. Of the two measures of structural equivalence, Pearson's correlation is associated more strongly with perceived similarity ($r = .32$) than is Euclidean distance ($r = .03$). Neither of these correlations is significant, however. Moreover, perceived similarity is associated more strongly with general equivalence than with structural equivalence. Measures of both general equivalences, MAXCORR and REGE, have .52 correlations with perceived similarity (with probability values $< .001$, based on multiple comparisons).[1]

Recall that structural equivalence simply is a very strict general equivalence. If two people have the same ties to identical others, then certainly they have the same ties to similar others. In other words, all of the variance in perceived similarity that can be explained by structural equivalence measures should also be explained by the general equivalence measures. Structural equivalence based on Pearson's correlation explains about 10 percent of the variance in perceived similarity, whereas each of the two measures of general equivalence explains about 27 percent of the variance. Although much of the variance in perceived similarity remains unexplained, about 17 percent more of the variance in perceived similarity can be explained by general equivalences than by structural equivalence.

It appears that perceptions of similarity in this classroom were not restricted by cohesion. Two students could be perceived as similar, even if they were not closely related, or cohesive. Similarity perception seems to be sensitive to the patterns of social ties beyond the concrete awareness of which particular persons are tied together. Thus the more abstract conceptualization of positions, which social scientists believe correctly to reflect structural positions, seems also to reflect how individuals perceive similarities among their peers.

Automorphic and Regular Equivalence as Models of Perceived Similarity

Although both automorphic and regular equivalences are abstract conceptualizations of structural positions and do not depend on ties to specific others, they differ in an important way. According to automorphic equivalence, two people occupy the same position if they have the same types of ties to the *same number* of similar others. In contrast, two people can occupy the same regularly equivalent position *regardless of the number* of similar others to whom they are tied, as long as they are involved in similar types of ties with at least one similar other.

[1] In response to a reviewer's comment, we calculated the significance of differences between correlations using the t-test described in McNemar (1962). The difference between r(perceived similarity, REGE) and r(perceived similarity, Pearson's r) (.52 − .32) is significant at the .01 level. The difference between r(perceived similarity, MAXCORR) and r(perceived similarity, Pearson's r) (.52 − .32) also is significant at the .01 level. The cases, however, are dyads; therefore they are not independent observations. The reported significance levels should be interpreted with extreme caution.

Table 2. Pearson's Correlation Coefficients among Positional Similarity Measured in Each of Four Ways and Overall Perceived Similarity

	Structural Equivalence (Euclidean distance)	Structural Equivalence (Pearson's correlation)	Automorphic Equivalence (MAXCORR)	Regular Equivalence (REGE)
Perceived Similarity ($\overline{X}=3.43$, sd$=.96$)	.03	.32	.52**	.52**
Structural Equivalence (Euclidean distance) ($\overline{X}=3.59$, sd$=.48$)	—	−.58**	−.35	−.34
Structural Equivalence (Pearson's correlation) ($\overline{X}=.54$, sd$=.13$)	—	—	.54**	.69**
Automorphic Equivalence (MAXCORR) ($\overline{X}=.87$, sd$=.09$)	—	—	—	.86**
Regular Equivalence (REGE) ($\overline{X}=.72$, sd$=.07$)	—	—	—	—

Note: Significance levels were computed using Bonferroni's method for multiple comparisons.
* Overall p <.05.
** Overall p <.01.
N = 153 dyads.
z-scores were calculated using nonparametric permutation tests because of the nonindependence of the cases. The magnitudes of the z-scores are comparable to the Pearson's correlation coefficients and are not reported.

The two measures of general equivalence, however, were associated equally with the overall perceived similarity among the class members. Thus, on the basis of positions in the network composed of all four relations, class members' perceptions appeared insensitive to degree. In other words, it appears that two people were considered similar as long as they interacted a great deal with at least one person (for example), but it did not seem to matter if one of those individuals interacted a great deal with many other people.

So far we have calculated positional similarities on the basis of three different types of relations: class interaction, social interaction, and affect. A separate examination of class members' positional similarities in each of these relations helps us to understand how structural positions are associated with perceived similarity.

Correlations between positional similarity in each type of relation are reported in Table 3. Positional similarities in class interaction and in social interaction are associated with each other more highly ($r=.62$, $r=.79$) than is either with positional similarities in the affect network ($r=.30$, $r=.21$, $r=.31$, $r=.30$). This is true for positional similarities based on either general equivalence. Although interaction in class and social interaction are different relations ($r=.24$), positions in the interaction relations seem similar to each other and different from positions in the affect structure. Thus we used MAXCORR and REGE to measure positional similarity in the interaction network consisting of both class and social interaction.

Positional similarities in interaction and in affect are compared with perceived similarities in Table 4. Positional similarity in the affect structure was associated more highly with perceived similarity than was positional similarity in the interaction network. This is

Table 3. Pearson's Correlation Coefficients among General Positional Similarities in Each Type of Relation

	Social Interaction	Affect
Automorphic Equivalence (MAXCORR)		
Class Interaction ($\overline{X}=.85$, sd$=.15$)	.62**	.30
Social Interaction ($\overline{X}=.67$, sd$=.22$)	—	.21
Affect ($\overline{X}=.89$, sd$=.09$)	—	—
Regular Equivalence (REGE)		
Class Interaction ($\overline{X}=.88$, sd$=.11$)	.79**	.33
Social Interaction ($\overline{X}=.69$, sd$=.18$)	—	.30
Affect ($\overline{X}=.84$, sd$=.07$)	—	—

Note: Significance levels were computed using Bonferroni's method for multiple comparisons.
* Overall p <.05.
** Overall p <.01.
N = 153 dyads.
z-scores were calculated using nonparametric permutation tests because of the nonindependence of the cases. The magnitudes of the z-scores are comparable to the Pearson's correlation coefficients and are not reported.

Table 4. Pearson's Correlation Coefficients among General Positional Similarities in Interaction and Affect Networks with Perceived Similarities

	Correlaton with Perceived Similarity
Automorphic Equivalence (MAXCORR)	
Interaction	
($\bar{X}$ = .83, sd = .15)	.30*
Affect	
($\bar{X}$ = .89, sd = .09)	.53**
Regular Equivalence (REGE)	
Interaction	
($\bar{X}$ = .74, sd = .11)	.39*
Affect	
($\bar{X}$ = .84, sd = .07)	.48**

Note: Significance levels were computed using Bonferroni's method for multiple comparisons.

* Overall $p < .05$.

** Overall $p < .01$.

N = 153 dyads.

z-scores were calculated using nonparametric permutation tests because of the nonindependence of the cases. The magnitudes of the z-scores are comparable to the Pearson's correlation coefficients and are not reported.

true both for positional similarity calculated with MAXCORR (r = .53 and r = .30) and for positional similarity calculated with REGE (r = .48 and r = .39).

On the basis of interaction relations, regular equivalence is correlated more highly with perceived similarity than is automorphic equivalence. In the affect structure, however, automorphic equivalence is correlated more highly with perceived similarity than is regular equivalence. This finding suggests that class members were not sensitive to degree when perceiving similar patterns of interaction, but that they were sensitive to degree when perceiving patterns of liking and disliking.

DISCUSSION

The primary aims of this research were to establish that patterns of social structure influence perceptions of interpersonal similarity and to identify which models of network positions correspond most closely to these perceptions. In the classroom setting of this study, perceptions of similarity among the students were associated most closely with measures of general equivalence. This finding suggest that contemporary models of positions in social networks correspond to the perceptions of "real people" as well as to scientific theories. People appear to be sensitive to abstract patterns of interaction in their social world. Thus the concept of social role, as defined by abstract patterns of ties (general equivalence) rather than by ties to specific others (structural equivalence), appears to be a part of people's perceptions of their social environment.

Positions based on general equivalences in the affect network seem to contribute to similarity perception differently than do positions in the interaction network. Positional similarities in the affect structure were associated more strongly with perceived similarity than were positional similarities in the interaction structure. Recall that some of the class interaction was imposed. In addition, although social interaction was voluntary, most of it occurred outside the classroom and was unobservable to many students. On the other hand, the measured relation of task-related affect is entirely voluntary. Positive affect between two people usually is associated with high interaction between them. In this setting, something that is associated with perceived similarity must have been observable in affect ties, in addition to interaction patterns.

Automorphic equivalence and regular equivalence in the entire network of relationships were associated equally with perceived similarity. Therefore, on the basis of all types of relations, the students' perceptions of similarity seem not to be sensitive to the number of others with whom a person has relations. The MAXCORR algorithm, however, is only a first-order approximation of automorphic equivalence. Clearer results might be possible if more accurate algorithms were available. Moreover, comparison between automorphic and regular equivalence in the interaction relations and in the affect relations suggests that perceptions of similarity might have been sensitive to degree in affect, but not in interaction. Perhaps when people perceive similarity in formal structures, they notice only roles, or types of ties in which another person is involved, without regard for the number of ties. The imposed nature of some of the class interaction may have had the same effect on perceiving similarity as do formal structures. This argument suggests that in an entirely informal community, where all interactions are voluntary, perceptions of similarity would reflect automorphic equivalence in interaction patterns as well as in affect patterns.

It may be that students in this study reported perceived similarity based on abstract notions of position because they were instructed explicitly to focus on *similarities* rather than on *friendships* (cohesion). Perhaps if the students had not been directed to ignore cohesion, their unconstrained perceptions of similarity would have been associated more strongly with structural equivalence. In addition, the students in this classroom did not know each other at the beginning of the semester, and the structure of social ties developed over several weeks. Perhaps in a setting with a baseline cohesive structure, perceptions of similarity might be formulated differently. Thus future research might consider cohesiveness as well as positional similarity as stimuli for perceptions of interpersonal similarity.

Previous research has shown that perceived similarity is related to personality traits and to task-related attributes (Davison and Jones 1976; Isenberg and Ennis 1981; Jones and Young 1972). Yet, although people who have similar attributes (e.g., same sex) are perceived as more similar than those with different attributes, it may be that people with similar attributes have similar interaction patterns; this possibility would explain why they might be perceived similarly. In fact, using structural equivalence as the model of positions, Arabie (1984) and Breiger and Ennis (1979) found that attributes of people occupying the same structural position tend to be similar.

The causal directions of these associations is unclear, and the relationships among perception of similarity, personal attributes, and social structure are complex. The current research addressed a small piece of this puzzle. The results suggest that general equivalence models of positions in social networks are associated with perceptions of similarity and provide evidence for the value of structural variables. Social structure is an observable part of the world we live in, and research to help us understand how we perceive that world should consider structural patterns in the relations among people around us.

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