# Patterns in the Recall of Persons in a Department of a Formal Organization*

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ABSTRACT: This paper describes the cognitive structures people use to organize persons in memory. Employees of a department in the public affairs division of a university free listed the names of coworkers. Perceived work proximity was the primary and general associative factor in subjects' recalls of fellow employees. That is, persons who were recalled successively were perceived to work more closely with one another than would be expected by chance. The temporal features of subjects' recalls also reflected the influence of perceived work proximity as an associative factor. In addition, perceived work proximity impacted associative patterning in the recalls of a subset of subjects who were instructed, at retest, to recall persons in alphabetical order of persons' first names. Serial order response patterns (which persons tended to be recalled earlier or later in recall) were related to persons' status and perceived work proximity to the subject. These results, along with two recent studies (Brewer 1993; Brewer and Yang 1994), strongly suggest that members of a community share a common cognitive structure of community members that is based on the community's social structure.

KEY WORDS: cognitive structure, organization of memory, person memory, social networks

## INTRODUCTION

The study of human social cognition in general, and person memory in particular, has historically relied on experiments in laboratory settings (Fiske and Taylor 1984; Higgins and Bargh 1987). Stimuli in these experiments, such as written descriptions of fictionalized persons, have usually focused on persons' individual traits (e.g., gender, ethnicity/race, personality, age, attitudes, behaviors, and interests) and typically lack social context. Consequently, relatively little is known about the role of *social structural* factors in human social cognition. Recently, however, more attention has been paid to how individuals remember, perceive, and think about the social relations among persons in the social communities in which they are involved (e.g., Bernard and Killworth 1977; Bernard, Killworth, and Sailer 1979/80, 1982; Boster, Johnson, and Weller 1987; Burt and Bittner 1981; Cairns, Perrin, and Cairns 1985; Delfosse and Smith 1979; Freeman 1992; Freeman, Freeman, and Michaelson 1988, 1989; Freeman, Romney, and Freeman 1987; Killworth and Bernard 1976; Marshall and McCandless 1957; Romney and Faust 1982; Romney and Weller 1984; Sluckin and Smith

1977; Smith and Delfosse 1978, 1980). The research reported in this paper complements this work by examining the social structural influences on how people remember and think about *persons* in the social communities to which they belong.

Cognitive psychology has made considerable progress in the understanding of how lexical items are organized in memory (for an introduction to the subject, see Puff 1979). By studying the way in which people list words in free recall, psychologists have demonstrated repeatedly that semantic similarity is the primary factor in the organization of lexical items in memory. No such consensus has yet developed about how persons are organized in memory, perhaps because of the multidimensionality of persons in natural contexts and the fact that study of the topic has only recently begun.

There are at least three conceptually distinct types of response patterning that can be observed in free recall: association, frequency, and serial order. Associative patterns refer to the connections or relationships between adjacently recalled persons (or lexical items, etc.). By noticing how a subject associates from one person to the next in free recall, that subject's underlying cognitive structure of those persons may be described. Frequency patterns refer to which particular persons or types of persons are recalled. Persons recalled by a subject are naturally more salient in that subject's mind than those persons not recalled. Serial order patterns refer to which particular persons or types of persons are remembered earlier or later in recall. Persons' output serial positions in recall also index their salience (with persons mentioned earlier considered more salient), and may reflect a subject's particular orientation or bias toward searching the cognitive structure of those persons.

Brewer (1993) reviewed relevant research on the memory of persons in natural contexts. This research suggests there are at least four possible general structures that could underlie associative patterns in the recall of persons' names: social relational structures (such as kinship or social interaction), persons' individual characteristics (such as gender, ethnicity/race, or personality), persons' spatial/geographic location, and the alphabetic/acoustic similarity of persons' names. Previous work also indicates that frequency patterns seem to be related to the intensity of social ties between the subject and persons recalled and persons' visibility in a community. Although there is little direct evidence, the same factors appear to be involved in serial order patterns in the recall of persons.

Perhaps the most extensive research on the patterns in the recall of persons has focused on the recall of acquaintances, or all persons known to a subject (Bond and Brockett 1987; Bond, Jones, and Weintraub 1985; Fiske this issue; Riegel 1973). The major finding from this work is that subjects' associative patterns reflect the multiple social contexts (or communities) in which they are involved. That is, when subjects free list



acquaintances, they tend to cluster, or mention successively, persons from the same social context (e.g., family, work, school, church, etc.). This demonstrates quite clearly that, at a very general level, persons are organized in memory according to social structural principles.

The study of the recall of persons in socially bounded communities allows examination of more detailed social structural influences on memory organization and permits investigation of whether individuals in such communities share a cognitive structure of community members. Brewer (1993) reported an analysis of the three types of response patterning in the recall of persons among students in a graduate academic program. Subjects in that study tended to cluster persons by cohort (year) in the program, typically beginning with persons in their own cohort, and then moving to cohorts that were progressively more distant (in chronological terms) from their own. Persons who were in cohorts chronologically distant from a subject were less likely to be recalled than persons in cohorts chronologically close to a subject. That study, however, was not able to show which aspect of the program's cohort structure – the cohort's formal organizational properties or the tendency for social interaction patterns to parallel the cohort structure – was more critical in organizing persons in memory.

Focusing on the role of social interaction in person memory, Brewer and Yang (1994) examined the patterns in the recall of persons in a Christian fellowship of Taiwanese and Taiwanese-American young adults. They found that subjects clustered fellowship members in recall in terms of perceived social proximity, with adjacently recalled persons tending to be socially much closer than expected by chance. Persons who were more visible in the fellowship and who were socially close to an individual subject were more likely to be recalled than other persons. Similarly, subjects tended to mention higher visibility persons earlier in recall than lower visibility persons. Two subjects spontaneously attempted to recall persons in alphabetical order of their first names, yet their response patterns still were related to perceived social proximity.

This paper reports a study of the recall of persons in a community – a department of a formal organization – differing in structure, function, and composition from those studied earlier. This study provides an in-depth analysis of social structural and other factors in the recall of persons, further outlining the fundamental aspects of how persons are organized in memory. In addition, this study investigates the effects on recall patterns when subjects are instructed to recall persons in alphabetical order of their first names. This recall task tests whether persons are also organized in memory alphabetically and if the influence of an underlying cognitive structure persists under such recall constraints.

## METHOD

### *Ethnographic background*

The community studied was a department within the public affairs division of a research university in the southwestern US. The two primary functions of the department were media relations and publications. Media relations involved the preparation of press releases and news articles on university programs, activities, faculty, staff, and students, and included the coordination of contact between the media and university personnel. The publications function comprised the production of internal and external university publications, entailing artistic design, photography, and printing. The campus radio station also was under the umbrella of the department.

The department took its present organizational form after a merger of the media relations and publications functions, which occurred a little over two years prior to data collection. At the time of data collection, there were 21 persons employed in the department. The department occupied part of a floor of a multi-storied building, with most employees' offices and cubicles located on the perimeter of this space and a few employees' cubicles located in the middle of the space. Persons who worked closely with one another tended to have offices close to each other, although this was not always the case. Two employees' offices were located elsewhere on campus.

The 21 employees included 16 females and 5 males, and no two employees shared the same first or last name. In addition to persons whose work duties were generally focused on media relations or publications, there were several administrative support employees. The organizational status hierarchy had five basic ranks. At the top of the hierarchy was the director of the department. The second level included managers ($n$ = 5 persons) of particular department functions who reported directly to the department director. The professional and technical staff ($n$ = 7 persons), all of whom had the word "senior" in their official job title, occupied the third level. The fourth level included the administrative support and technical assistance staff ($n$ = 4 persons), all of whom had the word "assistant" in their official job title. Part-time student assistants and interns ($n$ = 4 persons) held the fifth and lowest rank in the departmental status hierarchy.

In addition to normal work-related interaction, most employees in the department regularly went out to lunch with one or more of their coworkers. The department set aside part of one afternoon a week as a snack time, during which employees in the department socialized with one another. A few employees also maintained friendships with each other outside of work.



### *Subjects*

Subjects were thirteen employees of the department, including eleven females and two males. Eleven of the subjects were full-time employees and two were part-time student assistants. All had offices or cubicles at the department's main office location. Subjects' mean age was 35.5 years (range: 19 to 55 years) and had worked in the department for a mean of 4.4 years (range: 3 months to 11 years, 6 months). Eleven subjects were European-American, one was Korean-American, and one was Chinese-American. Individuals from each status level and main departmental function were represented in this sample.

### *Procedure*

Ten subjects participated in two interviews, and three subjects participated in one interview in fall of 1992 (see Table I). All interviews were conducted individually and privately in a vacant office in the department, except for one interview which was carried out in an office in another building on the university's campus.

The first interview (for the ten subjects who were interviewed twice – in first row of Table I) consisted of a free recall task. I gave the following instructions orally to subjects for the free recall task:

> Who are all the people that work in the [department's name] Department? Please list aloud the names of all the people who work in the [department's name] Department. You do not need to mention your name.

No instructions were given regarding the order in which subjects were to list names and subjects were allowed as much time as needed to mention all the persons they could. When subjects appeared to be done or said they had listed everyone, I prompted them once by asking if there were

TABLE I
Summary of tasks performed by subjects.

| | | |
|---|---|---|
| Subjects ($n$ = 10) interviewed twice | first interview:<br>– free recall of persons' persons' names | second interview:<br>– free recall ($n$ = 5) or alphabetically directed recall ($n$ = 5) of persons' names<br>– work and socializing proximity pile sorts<br>– ego rankings, boss perceptions<br>– demographic and work history info. |
| Subjects ($n$ = 3) interviewed once | – free recall of persons' names<br>– work and socializing proximity pile sorts<br>– ego rankings, boss perceptions<br>– demographic and work history info. | |

any other persons in the department; in 9 of the 23 interviews, subjects mentioned additional persons after this prompt. Subjects' responses were recorded on audiotape. In all interviews, subjects were not given any prior indication about the number or specific nature of the tasks to be performed except for the instructions immediately preceding a task. Subjects were asked not to discuss the study with other departmental employees until data collection was finished.

The second interview (for those ten subjects who were interviewed twice) occurred two to three weeks after the first interview. The second interview began with a recall task. Five subjects were assigned to a free recall task (as in the first interview) and 5 were assigned to an alphabetically directed recall task. Two subjects were intentionally assigned to the free recall task for the second interview (the reason for this is described in the results section). Of the remaining 8 subjects, three were randomly selected for the free recall task and the 5 others were assigned to the alphabetically directed recall task. For the alphabetically directed recall task, I gave the same oral instructions as in the first interview, except for the second sentence, which was replaced with: "Please list aloud the names of all the people who work in the [department's name] Department in alphabetical order by their first names as best as you can."

After the recall task in the second interview, subjects performed two quasi-successive pile sort tasks (cf. Boster 1987; Freeman *et al.* 1988). The full name (or as much as was known) of each different person mentioned by subjects in the first interview was written on a separate $3'' \times 5''$ notecard. (No additional persons were mentioned in the second interview.) Subjects sorted persons for two different social relations: how closely persons worked with one another (work proximity) and how much persons socialized with one another (socializing proximity). The order in which subjects performed the pile sort tasks was balanced across subjects. For each pile sort task, subjects were first asked to separate out from the set of randomly shuffled cards those persons whom they did not recognize, i.e., could not match the name with a face. For the work proximity pile sort task subjects were instructed to:

> Sort these persons into different piles according to how much they work with each other on job-related activities. Put persons that work with one another into the same pile.

For the socializing proximity pile sort task, subjects were instructed to:

> Sort these persons into different piles according to how much they socialize with each other, such as going to lunch together, meeting outside of work after hours, and/or talking with each other about things unrelated to work or the [department's name] department. Put persons that socialize with one another into the same pile.

After the initial sort, a subject was asked to loosen her/his criterion for working together (socializing) and, if possible, join piles of persons into larger groupings on the basis of working together (socializing). This step was repeated with further loosening of the subject's criterion until the subject did not perceive larger groupings (other than the whole department as one pile). At this point, the cards were rearranged into the piles the subject made in the initial sort. Then the subject was asked to tighten her/his criterion for working together (socializing) and, if possible, split piles of persons into smaller groupings of persons who worked (socialized) more intensely with each other. This step was repeated until the subject did not perceive finer groupings (other than each person as a different pile).



Subject's responses to these tasks constitute their *perceptions* of work and socializing proximities among persons in the department – i.e., perceptions of the department's work and socializing networks. Individuals' reports of interaction patterns in pile sort tasks have been shown to be highly accurate with respect to observed interaction patterns (Freeman *et al.* 1988, 1989; Webster 1993/94). For the sake of brevity, in the remainder of the paper perceived work and socializing proximity will be referred to without the modifier "perceived."

Following the pile sort tasks, each subject ranked persons in terms of how much s/he worked with them (ego rankings), and also listed each person's boss (defined as "the individual who most directly supervises and evaluates the person"). The ego ranking and boss perception tasks were given in a balanced order across subjects. The final part of the second interview entailed subjects answering demographic questions and providing information about their personal work histories in the department. The three subjects who only participated in one interview (in second row of Table I) performed the free recall task and the same set of other tasks as the subjects in the second interview. The analysis of these subjects' recalls is presented with the other subjects' first interview recalls.

## RESULTS

In the first interview, the 13 subjects took a mean of 59 seconds (range: 28 to 133 seconds) to name all the persons in the department that they could. The mean number of persons recalled by the 13 subjects was 16.0 (range: 12 to 20), excluding repetitions and self-mentions. One subject repeated a person's name and two subjects mentioned themselves. Self-mentions in both interviews were not included in any analysis. There were four cases in the two interviews where a subject did not mention a person's name but gave a clear enough description of the person to permit identification of that person. A total of 23 persons were mentioned by at least one subject in the first interview. These 23 persons included all of the 21 persons then employed in the department and two other persons – a student intern no longer working in the department and another person named by only one

subject (in the pile sort tasks, this person was recognized by only three subjects who said this person was a student assistant).

In the second interview, alphabetically directed subjects took a mean of 114 seconds (range: 45 to 159 seconds), while free recall subjects took a mean of 28 seconds (range: 20 to 34 seconds) to list all the persons in the department they could. The alphabetically directed subjects recalled a mean of 16.6 persons (range: 14 to 20) and the free recall subjects recalled a mean of 15.6 persons (range: 14 to 19). There were no significant differences between the numbers of persons recalled by subjects in the two interviews or between the numbers of persons alphabetically directed and free recall subjects mentioned in the second interview. One subject repeated one name, another subject repeated two names, and a third subject mentioned his own name in the second interview. A total of 21 persons (all those employed in the department at the time) were mentioned by at least one subject in the second interview. In the pile sort tasks, subjects recognized a mean of 21.4 persons (range: 20 to 23). In the work proximity pile sort task subjects created a median of 6 levels of sorting (range: 3 to 17) and in the socializing proximity pile sort task subjects used a median of 5 levels of sorting (range: 3 to 18).

*Associative patterns*

*Measurement of clustering.* Clustering (or association in recall by a given scheme or variable (such as gender or work proximity) was measured by a path length statistic based on quadratic assignment independently developed by Hubert and Levin (1976) and Carroll, Romney, Farner, and Delvac (1976). This procedure first involves defining a square, symmetric matrix of hypothesized associative strengths among the items (in this case, persons' names) for a particular scheme. This matrix may be binary (as in the case of a categorical associative structure), or valued (where the associative strengths are measured on an ordinal or higher scale). In the present study, associative strength matrices contained similarities or proximities between persons (to be described), except where noted otherwise. When these matrices were binary, "1" represented common category membership and "0" otherwise.

Next, a subject's recall order of persons can be considered as a path through a graphic representation of an associative strength matrix, where there is a link between each pair of persons. The value of a particular line $l_{ij}$ is the value of the $(i, j)$ cell in the associative strength matrix. The number of links in a subject's path is equal to the number of persons recalled minus one. The weighted length of a subject's path is defined to be the sum of the link values for the adjacently recalled pairs of persons. Self-mentions were not included in a subject's recall path. When a subject's recall included repetitions, the subject's observed weighted path length was reduced by the number of repetitions times the mean link value for the total path.



Since associative strength matrices represented proximities or similarities among persons for particular schemes, an observed path length *longer* than expected by chance indicated clustering. The expected by chance path length is the mean path length for all possible paths among those persons recalled by a subject (i.e., for all permutations of the recall order). For a given scheme, clustering of persons in recall was specifically indexed for each subject by simulating 10,000 random paths among just the set of persons a subject recalled and noting the proportion of path lengths that were at least as large as the subject's observed path length. These one-tailed Monte Carlo probability values thus estimate the *significance* of a subject's clustering according to a given scheme. For most clustering schemes, the distribution of all possible path lengths among the set of persons recalled by a subject was skewed to the right, therefore requiring this nonparametric approach to measuring clustering. The measurement of clustering in recall against a single scheme is referred to as zero-order clustering in this paper.

To give a perspective on the *magnitude* (as opposed to the significance) of clustering, Adjusted Ratio of Clustering (ARC) scores (Roenker, Thompson, and Brown 1971) were computed when the associative strength matrix was binary. This measure equals $(o - e)/(m - e)$, where $o$ is the observed path length, $e$ is the expected path length, and $m$ is the maximum possible path length. The ARC ranges between $-1$ and 1, and takes a value of 0 when the observed path length is equal to the expectation and a value of 1 for maximum clustering.

*Zero-order clustering in recall.* In order to investigate the influence of work proximity on associative patterning in recall, a work proximity associative strength matrix was created from the pile sort data. For each subject, the groupings of persons sorted were ordered into levels from broadest (where the subject could not join any more piles) to narrowest (where the subject could not split any pile further). The work proximity of a pair of persons from the perspective of each subject was indexed by a proportion representing the number of levels the pair was placed in the same pile divided by the total number of levels that subject used in the task. The work proximity values for each pair of persons were averaged across all subjects who recognized both persons in that pair to arrive at an aggregated work proximity associative strength matrix. Unless otherwise noted, all work proximity values used in analysis were based on this aggregation.

Subjects' recalls in the first interview exhibited highly significant clustering by work proximity. The pairs of persons recalled adjacently by a subject worked much more closely than would be expected by chance. Table II shows the median and range of the Monte Carlo work proximity

TABLE II
Associative patterning results for different clustering schemes, first interview.

| Clustering scheme | Monte Carlo clustering $p$ values | | Number of Ss with $p < 0.05$ |
|---|---|---|---|
| | Median | Range | |
| Work proximity | 0.0009 | < 0.0001 to 0.0148 | 10 |
| Socializ. proximity | 0.0072 | 0.0003 to 0.0735 | 9 |
| Status | 0.0432 | < 0.0001 to 0.7285 | 5 |
| Gender | 0.4278 | 0.1287 to 1.0 | 0 |

*Note*: Results based on $n = 10$ subjects.

clustering probability values for 10 subjects in the first interview. All 10 subjects clustered by work proximity at $p < 0.02$. Three subjects' recalls from the first interview were not included in this summary since their recalls were clearly locationally oriented. As revealed by their spontaneous comments and inspection of their recalls, these subjects systematically recalled persons by mentally "walking around" the perimeter and then center of the office space, listing persons as their offices were encountered. Except where otherwise noted, the first interview results reported in this paper do not include these subjects. There were no noticeable differences in the significance of work proximity clustering for the 10 subjects in the first interview when each subject's recall was tested for clustering against her/his own individual work proximity matrix (median $p = 0.0019$, range: < 0.0001 to 0.0353).

Subjects' recalls also displayed significant clustering by the socializing proximity and status schemes. An aggregated socializing proximity matrix was constructed from the pile sort data in exactly the same way as with work proximity. Clustering by socializing proximity was almost as significant as that by work proximity (see Table II). All 10 subjects in the first interview clustered by socializing proximity more than expected by chance and 9 subjects clustered at $p < 0.05$, but the median $p$ (0.0072) was slightly greater than that observed for work proximity clustering (0.0009). Seven of the 10 subjects clustered more by work proximity than by socializing proximity.

To measure status clustering, a status associative strength matrix was created which indicated the pairs of persons holding the same status in the organizational hierarchy. Nine of the 10 subjects in the first interview clustered by status more than expected by chance and 5 subjects clustered at $p < 0.05$ (see Table II). The mean status ARC was 0.45.

Clustering by gender was measured after constructing a gender associative strength matrix which indicated the pairs of same gender persons. Subjects did not show any appreciable degree of clustering by gender (see Table II). Six of the 10 subjects in the first interview clustered by gender more than expected by chance, and no subject clustered at $p < 0.05$.



The results for the free recall subjects in the second interview mirrored the first interview results (see Table III). As in the first interview, the recalls of 3 subjects' were obviously locationally oriented (two of these subjects had locationally oriented recalls in the first interview and were intentionally assigned the free recall task for the second interview to see if they would use the same recall strategy; the third locationally oriented subject from the first interview was only interviewed once). Except where otherwise noted, the second interview results reported in this paper do not include these subjects.

The recalls of the five alphabetically directed subjects in the second interview also demonstrated similar associative patterns to the free recalls of subjects in the first interview (see Table III). All 5 of these subjects clustered more by work proximity than by socializing proximity. Alphabetically directed subjects recalls', though, also showed alphabetic associative influences, with moderate clustering by first letter of first name (median $p = 0.1489$, range: 0.0008 to 1.0, mean ARC = 0.38). Subjects' recalls in the first interview were not characterized by first letter of first name clustering (median $p = 0.5326$, range: 0.0687 to 1.0), nor were the recalls of the 2 free recall subjects in the second interview (both $p$'s = 1.0).

The recalls of locationally oriented subjects in both interviews were strongly clustered in terms of the distance between persons' offices, as would be expected. The shortest walking distances between each pair of person's offices/cubicles were measured from a blueprint of the main office location and arranged in a location distance associative strength matrix. In the location distance clustering analysis, persons who did not have an office in the main office location were omitted from subjects' paths. Also, because the location matrix contained distances (instead of proximities), the significance of a subjects' clustering by location was assessed by the proportion of randomly generated paths as short or shorter than the observed

TABLE III
Assiociative patterning for different clustering schemes, second interview.

| Clustering scheme | Monte Carlo clustering $p$ values | | |
|---|---|---|---|
| | Free recall Ss[a] | Alphabetically directed Ss[b] | |
| | | Median | Range |
| Work proximity | < 0.0001, 0.0040 | 0.0031 | < 0.0001 to 0.5457 |
| Socializ. proximity | < 0.0001, 0.0034 | 0.0759 | 0.0001 to 0.8079 |
| Status | 0.1716, 0.2309 | 0.3403 | 0.0064 to 0.5751 |
| Gender | 0.1119, 1.0 | 0.3845 | 0.1068 to 1.0 |

[a] $n = 2$ subjects. [b] $n = 5$ subjects.

recall path. In the first interview, the three locationally oriented subjects' location distance clustering $p$'s were < 0.0001, < 0.0001, and 0.0044. The 3 locationally oriented subjects in the second interview had location distance clustering $p$'s of < 0.0001, < 0.0001, and 0.0480. However, clustering by location distance was not restricted to the locationally oriented subjects. The 10 non-locationally oriented subjects in the first interview showed modest clustering by location distance (median $p = 0.1247$, range: 0.0005 to 0.2447). In the second interview, the 2 non-locationally oriented free recall subjects also displayed some clustering by location distance ($p$'s = 0.0020 and 0.0346), as did the 5 alphabetically directed subjects (median $p = 0.0949$, range: 0.0113 to 0.7424).

It was not possible to determine from the foregoing analyses which clustering scheme was the most predominant in subjects' recalls. Currently there exists no index of the significance and/or strength of clustering that is comparable across clustering schemes with different scales of measurement (e.g., work proximity, socializing proximity, and location were measured on an interval scale while the other schemes were measured in terms of binary categorical structures). However, by examining clustering by one scheme *within* and *between* clusters of persons defined by other schemes, one can ascertain whether a particular clustering scheme is general, and thus likely to be the underlying cognitive structure. I postulated that work proximity was this scheme. Of the clustering schemes examined, work proximity appears to be the theoretically most universal, since it represented persons' interaction patterns at work, the primary context of department members' interaction. Interaction among persons exists in every community but not all socially bounded communities have formal statuses. In addition, as described earlier, subjects displayed highly significant clustering by work proximity.

*Clustering by work proximity within and between same-status clusters.* I tested the generality and primacy of work proximity as an associative factor by examining the influence of work proximity *within* and *between* clusters of same-status persons. If status was the dominant scheme on which subjects' associative patterns were based, then there should be *no* work proximity clustering *within* or *between* status clusters. If status was the primary scheme generating subjects' associative patterns, then the associations between persons *within* same-status clusters should be essentially unrelated to work proximity. Similarly, if status was the underlying scheme on which subjects' associative patterns were genuinely based, then the associations between persons of *different* statuses should be independent of work proximity. In such a scenario, the observed clustering by work proximity would arise if status were confounded with work proximity.

In fact, pairs of persons holding the same status in the organizational hierarchy tended to work more closely with each other than expected by chance. The association between work proximity and status was assessed with the quadratic assignment procedure (QAP) (Hubert and Shultz 1975) as implemented in ANTHROPAC (Borgatti 1992) and UCINET (Borgatti, Everett, and Freeman 1992). QAP generates the equivalent of a permutation distribution of random rearrangements of a data matrix (here, the aggregated work proximity matrix) and tests the significance of hypotheses about the similarity or difference between the distributions of comparison groups. The comparison groups here were the two sets of pairs of persons defined by the binary status associative strength matrix. The hypothesis tested whether same status pairs of persons worked more closely with each other than different status pairs of persons. QAP $z$-scores index the difference between observed values (in the work proximity matrix) and expected values (from the permutation distribution) for the comparison groups specified in binary status matrix. QAP proportion as large values are nonparametric, one-tailed Monte Carlo probability values and here represent the proportion of times in 10,000 permutations that a difference occurred between comparison groups in the hypothesized direction at least as large as observed. The results showed that pairs of same status persons worked more closely with each other than would be expected by chance (QAP $z = 4.53$, proportion as large = 0.0010).



Furthermore, among different status pairs of persons, status and work proximity were also associated. For different status pairs of persons, the Pearsonian correlation between the absolute ordinal difference between status ranks and work proximity was –0.31 (i.e., pairs of persons occupying status levels near each other in the status hierarchy worked more closely with each other than those occupying very different status levels). This confounding of status with work proximity for different status pairs of persons precluded the use of the control clustering measure described by Brewer and Yang (1994).

Since subjects displayed overall homogeneity in the clustering results already described, the recall data were aggregated in order to perform the analyses of association by work proximity within and between status clusters. A 23 × 23 person by person adjacency in recall matrix was created from the 10 subjects' first interview recalls in which a cell represented the number of subjects who recalled that pair of persons adjacently divided by the number of subjects who recalled both persons. (Rubin and Olson (1980) also used this procedure for measuring adjacency in recall in one of their experiments). If no subject ever recalled both persons of a pair, then the cell for that pair was coded as missing data. This separated the effects of any frequency pattern (who tends to be recalled at all) from the effects of any associative pattern (who tends to be recalled adjacently to whom). No genuine associative pattern can be observed for two persons that have never been both recalled by a subject.

To measure the impact of work proximity on associative patterns within

and between same-status clusters of persons, the values in the adjacency matrix were correlated with the values in corresponding cells of the work proximity matrix for specified pairs of persons. For comparison, the same set of analyses was conducted replacing work proximity with socializing proximity. All sets of these correlations appear in Table IV. For pairs of same status persons generally and for same status pairs of particular ranks, pairs of persons that worked more closely together were more likely to be recalled adjacently than pairs of persons who worked less closely together. Thus, clustering by work proximity was very evident within clusters of persons defined by the status scheme.

For pairs of persons separated by a given number of status ranks, pairs of persons who worked more closely together were more likely to be recalled adjacently than pair who worked less closely together. This relationship was most obvious for pairs of persons separated by only one status rank, while for those pairs separated by two or three ranks, this relationship was weak to nonexistent. The weak correlations do not suggest, though, that status was a critical factor in these associations because status differences of 2 or 3 ranks signify relatively large status dissimilarities. Results for the six pairs of persons separated by four status ranks are not included in the table because none of these pairs was every recalled adjacently. Although the correlations between adjacency in recall and work proximity tended to be smaller for between status cluster pairs of persons than for within status cluster pairs of persons, these results indicate that subjects clustered by work proximity between clusters of same status persons.

TABLE IV
Clustering by work proximity and socializing proximity within and between clusters of same status persons.

| Pairs of persons | Pearson's $r$ between adjacency in recall and | | | |
|---|---|---|---|---|
| | work proximity | | socializing proximity | |
| | $r$ | $n$ | $r$ | $n$ |
| Same status | 0.49 | 48 | 0.34 | 48 |
| 2nd status rank | 0.23 | 10 | 0.06 | 10 |
| 3rd status rank | 0.92 | 21 | 0.76 | 21 |
| 4th status rank | 0.62 | 6 | 0.08 | 6 |
| 5th status rank | 0.10 | 11 | 0.35 | 11 |
| Different status | 0.19 | 195 | 0.25 | 195 |
| 1 rank difference | 0.27 | 92 | 0.38 | 92 |
| 2 rank difference | 0.06 | 67 | 0.03 | 67 |
| 3 rank difference | –0.19 | 30 | 0.04 | 30 |
| | 0.40 | 243 | 0.35 | 243 |



In addition, the influence of work proximity on associative patterning was not a byproduct of clustering by work sections. When only the 15 pairs of persons (involving 12 different persons) who held the same status and worked in the same work section (media relations, publications, administrative support) were considered, the relationship between adjacency in recall and work proximity was still clear, $r = 0.59$.

While the magnitude of the correlations in Table IV may not seem very large, the adjacency matrix was very sparse. This matrix, then, represented an incomplete set of data on the underlying or "true" likelihood of adjacent recall (i.e., transition probabilities) for all pairs of persons because of the small number of observed adjacently recalled pairs of persons relative to the total possible number of pairs of persons. Moreover, the smaller correlations for different status pairs of persons than for same status pairs may have been due in whole or in part to the restricted variation in adjacency in recall and work proximity values for different status pairs of persons. In comparison to same status pairs of persons, different status pairs of persons were also much less likely to be recalled adjacently (as would be expected from the significant status clustering results) or be judged as working closely together. For different status pairs of persons, the mean adjacency in recall value for different status pairs was 0.07 (s.d. = 0.14) and the mean work proximity value was 0.23 (s.d. = 0.20), whereas for same status pairs of persons, the mean adjacency in recall value was 0.28 (s.d. = 0.33) and the mean work proximity value was 0.39 (s.d. = 0.34).

Although there appeared to be modest zero-order clustering by location distance in subjects' free recalls, location distance did not have an effect on associative patterns independent of work proximity clustering. Location distance and work proximity were negatively correlated for the 19 persons for whom there were location distance data ($r = -0.46$), indicating that persons who worked closely with one another tended to have offices near each other. Once the effects of work proximity were partialled out, location distance was no longer significantly related to adjacency in recall ($p > 0.05$), as determined from a QAP multiple regression with 10,000 permutations (Krackhardt 1987, 1988). The independent effect of work proximity on adjacency in recall, though, remained highly significant ($p < 0.0001$).

Since work proximity was clearly the dominant and general associative factor in subjects' recalls of persons, the following principal components analysis was conducted in order to display this relationship graphically. For this analysis, a 21 × 21 person by person work proximity matrix was stacked on top of a 21 × 21 person by person adjacency in recall matrix (the rows and columns for the two persons only recalled by one subject in the first interview were omitted from both of the original 23 × 23 matrices). The main diagonals for each of these submatrices were coded as missing. Next, the row–row Pearsonian correlations were computed and the first two principal components of the resulting 42 × 42 correlation matrix

were extracted. These two dimensions accounted for 87.6% of the variance in the correlation matrix. Before plotting, the unweighted scores on a dimension were standardized for persons in terms of work proximity and standardized for persons in terms of adjacency in recall. These post-standardized scores were then multiplied by the square root of the dimension's singular value.

Figure 1 depicts the common structure between work proximity and adjacency in recall by projecting both configurations of persons (i.e., both sets of post-standardized and weighted scores on the first two dimensions) into the same space. In the figure, circles represent persons in terms of work proximity and triangles represent persons in terms of adjacency in recall. Persons (as circles) who are closer to each other in the figure were judged by subjects to work more with each other than persons who are farther apart. Persons (as triangles) who are closer to each other were recalled more

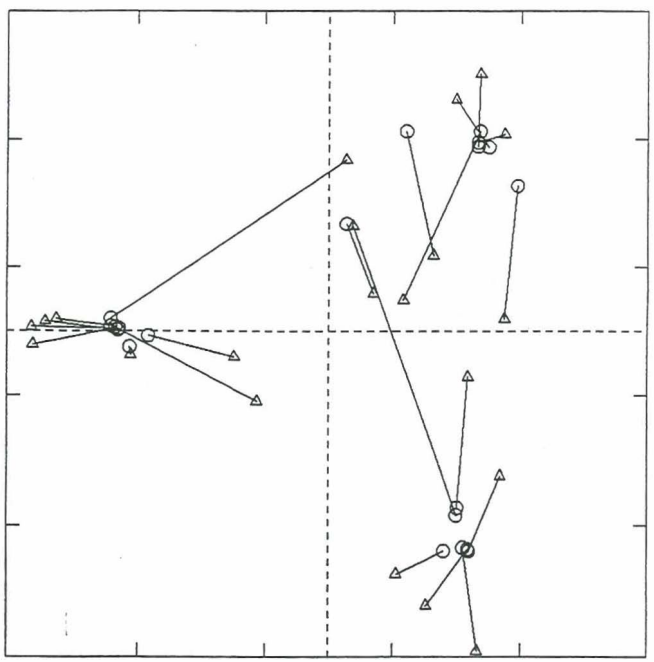

Fig. 1. Two-dimensional principal components analysis representation of persons in terms of work proximity (circles) and adjacency in recall (triangles) from aggregated data.



frequently adjacently than persons who are farther apart. Lines connect each person's position for work proximity to her/his position for adjacency. These lines tend to be short, illustrating the underlying similarity between work proximity and adjacency in recall. Persons in the left half of the figure were responsible for the department's media relations effort, while persons in the lower right quadrant were involved with publications. Persons in the upper right quadrant were generally administrative support staff.

*Temporal features of recall.* The amounts of elapsed time between adjacent responses in recall, or inter-response times (IRTs), also indicate how a subject associates from one person to the next. In cognitive psychology, it is generally assumed that IRTs reflect the strength of the connections in memory between successively recalled items. Thus, short IRTs here signify strong connections between persons in memory, while longer IRTs signify weaker connections. I measured the IRTs for each individual subject's recall in both interviews by replaying the audiotape-recorded recall interviews and pressing a button on a microcomputer keyboard at the instant the name of each person was mentioned. In those few cases where the subject only provided descriptive information about the persons, but not the person's name, the button was pressed when the subject began to mention the descriptive information. IRTs were electronically computed and precise to one hundredth of a second. The IRT procedure is the same used by Brewer and Yang (1994) and is very similar to those used by Gruenewald and Lockhead (1980) and Patterson, Meltzer, and Mandler (1971). Within-rater reliability was very high – the Pearsonian correlation between two IRT timing trials for a subject's recall was always > 0.99. The IRTs from the first timing trial were used in analysis.

IRTs for adjacently recalled pairs of persons involving self-mentions were excluded from analysis. During the interviews, there were also a few cases in which after a subject said s/he was done recalling persons, I stopped the audiotape recorder and then restarted it a few seconds later as the subject wanted to mention another person or two. IRTs involving persons mentioned after the tape was stopped and restarted were not included in any IRT analysis.

The temporal characteristics of subjects' recalls were substantially related to work proximity. For nearly all of the 10 subjects in the first interview, a consistent nonlinear pattern appeared when the work proximities for the adjacently recalled pairs of persons were plotted against the IRTs for those pairs of persons. The raw IRTs were short for adjacently recalled pairs of persons who worked very closely together, and the raw IRTs gradually increased as work proximity decreased to moderate levels of work proximity. At lower levels of work proximity, however, the raw IRTs increased much more abruptly.

The relationship between work proximity and IRT was best described for

most subjects' recalls by taking the natural logarithm of the raw IRTs. The mean Pearsonian correlation between log transformed IRT and work proximity was –0.63 (see Table V) and the mean Pearsonian correlation between log IRT and socializing proximity was –0.56. (Unless otherwise noted, the mean Pearsonian correlations reported in this paper were calculated by using Fisher's (1948) $z$ transformations and weighting by the number of observations). The cumulative $Z$ score (based on the transformed correlations and Stouffer's method of aggregation (Mosteller and Bush 1954)) for the log IRT × work proximity correlations was –7.97.

IRTs, in general, increased over the course of recall, as has been observed in free recall elsewhere (e.g., Bousfield and Sedgewick 1944; Brewer and Yang 1994). The mean Pearsonian correlation between log IRT and the output serial position for adjacently recalled pairs of persons for the 10 subjects' first interview recalls was 0.56 (range: 0.16 to 0.90). However, work proximity and output serial position were independent factors in describing IRTs. The mean untransformed partial correlation between log IRT and work proximity controlling for output serial position was –0.58 for the 10 subjects' first interview recalls (see Table V). Similarly, the mean untransformed partial correlation between log IRT and output serial position holding work proximity constant was 0.44 (range: –0.06 to 0.92). The effect of work proximity on temporal patterns, then, persisted throughout the course of recall.

Same status also had an accelerating influence on IRTs beyond the impact of work proximity and output serial position. In 8 of the 10 first interview subjects' recalls the log IRTs for same status pairs of adjacently recalled persons were quicker, on average, than expected from the multiple linear regression predicting log IRT from work proximity and output serial position ($p = 0.11$ from a sign test).

The recalls of subjects in the second interview exhibited temporal patterns

TABLE V
Temporal patterns for adjacently recalled pairs of persons.

| Subjects' recalls | $r$ log IRT × work prox. | Partial $r$ log IRT × work prox. \| output serial position |
|---|---|---|
| First interview[a] | | |
| mean | –0.63 | –0.58 |
| range | –0.88 to –0.18 | –0.88 to –0.04 |
| Second interview | | |
| free recall Ss[b] | –0.47, –0.51 | –0.35, –0.51 |
| alpha; dir. Ss[c] | | |
| mean | –0.26 | –0.29 |
| range | –0.54 to –0.04 | –0.44 to –0.09 |

[a] $n = 10$ subjects. [b] $n = 2$ subjects. [c] $n = 5$ subjects.



paralleling those observed in the first interview, although alphabetically directed subjects' results were somewhat weaker (see Table V). For both of the free recall subjects and 4 of the 5 alphabetically directed subjects, the mean log IRT was shorter for same status pairs of adjacently recalled persons than expected from the multiple linear regression predicting log IRT from work proximity and output serial position.

Furthermore, the temporal patterns of the locationally oriented subjects' recalls also appeared to be influenced by work proximity. The partial correlations between log IRT and work proximity controlling for location distance for the 3 locationally oriented subjects in the first interview were –0.53, –0.59, and 0.41 (mean = –0.24), and in the second interview were –0.32, –0.29, and –0.04 (mean = –0.22). When both location distance and output serial position were held constant, these values did not noticeably change (first interview mean = –0.22, second interview mean = –0.23). If each locationally oriented subject's recall in each interview were considered to be independent of each other (4 subjects were responsible for 6 locationally oriented recalls), then the 6 second-order partial correlations would be nearly significant as a set, with a cumulative $Z$ of –1.82 from aggregating the coefficients' $t$-scores (Winer 1971; Rosenthal 1991).

*Case study.* The results on associative patterns demonstrate that work proximity was the general and principal associative factor in subjects' recall of persons. The following case study of one typical subject's recall portrays the effect of work proximity on associative patterning. Figure 1 represents the work proximities among the 18 persons recalled by this subject (taken from the 23 × 23 work proximity matrix) with a maximum link hierarchical clustering (Johnson 1967). In the figure, the dashes at the branch ends represent persons. The level at which persons are joined horizontally by continuous X's reflects (though not perfectly) the degree of their work proximity. The three main subdivisions/work sections of the department can be seen fairly clearly. The numbers at the branch ends denote the output serial positions of these persons in this subject's recall.

This subject clustered by work proximity at $p = 0.0007$. Adjacently recalled pairs of persons tend to be joined high in the diagram and subsequences of successively recalled persons tend to correspond to the overall work proximity group structure.

This subject's recall also displayed the characteristic nonlinear pattern between adjacently recalled pairs of persons' work proximities and IRTs. Figure 2 shows the scatterplot between IRT and work proximity for the pairs of persons recalled adjacently by this subject. The numbers plotted in the figure represent the output serial positions of the 17 adjacently recalled *pairs* of persons. IRTs are very short for pairs of persons that work closely with each other, then tend to increase slightly as work proximity decreases, and tend to increase much more sharply for lower levels of work proximity.

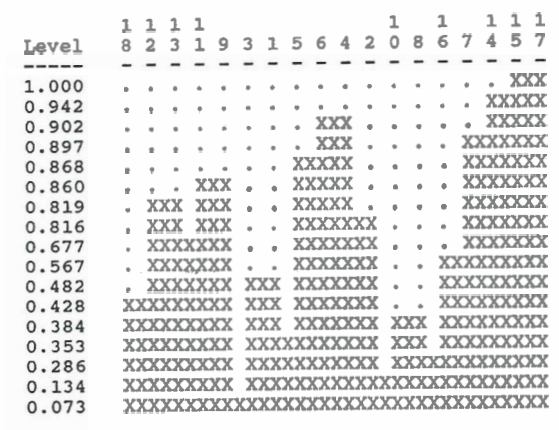


Fig. 2. Maximum link hierarchical clustering of the work proximities among the persons recalled by one subject. Numbers denote the output serial positions of persons.

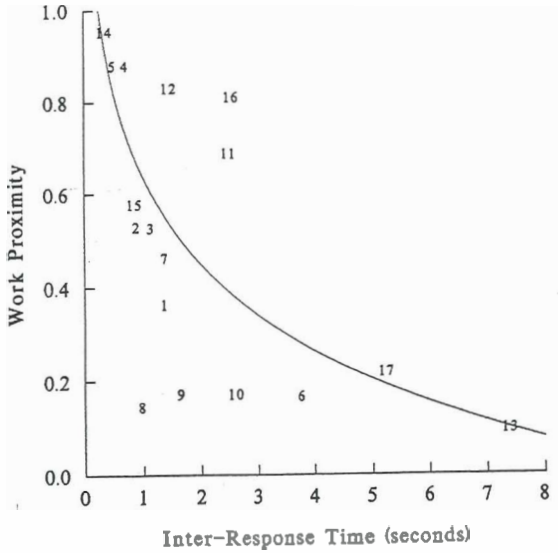


Fig. 3. For one subject, the relationship between work proximity and raw IRT for the adjacently recalled pairs of persons. Numbers denote output serial positions of pairs.



The Pearsonian correlation between log transformed IRT and work proximity for this subject was –0.62. The plotted curve indicates the log IRT expected from work proximity. This subject's partial correlation between log IRT and work proximity controlling for output serial position was –0.69.

*Frequency patterns*

As already noted, each subject recalled a large proportion of persons in the department in each interview. In both interviews, the director of the department recalled all persons then employed in the department. No other subject recalled all persons then employed in any interview. Since there were no other indications that individual subjects had fundamentally different frequency patterns from each other, frequency patterns are discussed here in terms of persons' overall frequency of mention (based on all the recalls of all subjects, including the locationally oriented subjects). Because subjects recalled most persons in the department, the focus here will be on those persons *not* mentioned by every subject in both interviews. The four persons recalled least often were: the two persons recalled once in the first interview (described earlier), a manager whose office was in another building and who had the lowest mean work proximity to others (recalled once in the first interview and twice in the second), and a part-time student assistant who also worked outside of the department's main office location (mentioned twice in the first interview and once in the second).

Of the remaining persons who were not mentioned by every subject, three were part-time students assistants (mentioned by 3 to 6 subjects in the first interview and by 6 to 8 subjects in the second), one was a managerial level employee that had just recently joined the department (recalled by 4 subjects in the first interview and by 5 subjects in the second), and another was a senior professional staff person who was on temporary leave (mentioned by 7 subjects in the first interview and by 8 subjects in the second). There were 6 other persons not mentioned by one or two subjects in the first interview and 4 persons not mentioned by one or two subjects in the second interview. These non-mentions were not patterned in any obvious way. Thus, the persons most likely recalled were simply the most visible in terms of regular physical presence – i.e., those who had an office in the main office location, were full-time employees, were currently working, and had been employed in the department for more than a short period of time.

The ten subjects who were interviewed twice exhibited relatively high test-retest reliability in the persons recalled in both interviews. For each subject, a Jaccard coefficient (intersection/union of two sets) was computed for the sets of persons recalled in the two interviews. The mean coefficient was 0.83 (range: 0.68 to 1.00).

*Serial order patterns*

The serial ordering in subjects' recalls was noticeably related to social structural variables, namely persons' status in the organizational hierarchy and persons' work proximity to the subject. The influence of status was most distinctly shown by the fact that the director of the department was named first by 6 of the 10 subjects in the first interview and by both free recall subjects in the second interview. Eight of the 10 subjects in the first interview had positive gamma correlations (Goodman and Kruskal 1954) between persons' output serial position and status rank (mean = 0.43, range: –0.12 to 0.76; mean $r = 0.52$, $Z = 6.47$). In other words, persons of higher status tended to be recalled earlier than persons of lower status. Status also impacted the serial order patterns in the 2 free recall subjects' recalls in the second interview, with gammas of 0.10 and 0.41.

Subjects also tended to mention persons that they worked with more closely earlier in recall than persons they worked with less closely. Two measures of a person's work proximity to a subject were available: subjects' responses in the ego ranking task and the work proximities from the work proximity associative strength matrix (based on the pile sort data). The following results are based on the former measure since they fit the observed serial order patterns slightly better. Nine of the 10 subjects in the first interview displayed positive gamma correlations between persons' output serial position and work proximity to the subject (mean = 0.26, range: –0.05 to 0.63; mean $r = 0.41$, $Z = 4.82$). The recalls of the 2 free recall subjects in the second interview showed a similar relationship, with gammas of 0.25 and 0.16. (In addition, the serial ordering in these two subjects' recalls was fairly similar across interviews. For each of these subjects, the gamma correlations (which are also Kendall's taus in this case) between persons' output serial positions (ranked) for the persons recalled in both interviews were 0.54 ($r = 0.70$) and 0.39 ($r = 0.56$), respectively).

Status, though, was modestly more influential than work proximity to a subject in describing serial order patterns. For 7 of the 10 subjects in the first interview, the status serial order gammas were larger than the work proximity serial order gammas. In addition, the mean partial correlation between output serial position and status holding work proximity to a subject constant was 0.41 (range = –0.17 to 0.72; $Z = 5.47$), which was greater than the mean partial correlation between output serial position and work proximity to a subject controlling for status, mean –0.30 (range: –0.17 to 0.61; $Z = 3.64$).

The alphabetically directed subjects in the second interview demonstrated comparable serial order results, although somewhat less in magnitude. All 5 subjects had positive status serial order gammas (mean = 0.28, range: 0.08 to 0.42; mean $r = 0.34$, $Z = 2.98$) and 4 of the 5 subjects had positive work proximity serial order gammas (mean = 0.19, range: –0.04 to 0.40; mean $r = 0.26$, $Z = 2.26$). The recalls of the alphabetically directed subjects, however, also showed an alphabetical serial ordering effect that free recall subjects in the first interview did not. All 5 alphabetically directed subjects had positive gammas between persons' output serial position and position in the alphabet of the first letter of persons' first names (ranked for the persons recalled by a subject) (mean = 0.28, range: 0.06 to 0.57; mean $r = 0.37$, $Z = 3.17$). In contrast, the mean alphabetical serial order gamma for the 10 subjects in the first interview was –0.02 (range: –0.37 to 0.10). The status serial ordering in alphabetically directed subjects' recalls was not due the alphabetical serial ordering: the mean partial correlation between persons' output serial position and status controlling for position in the alphabet for the first letter of persons' first names was 0.26 (range: 0.11 to 0.48; $Z = 2.11$). Incidentally, all 3 locationally oriented subjects in the first interview and 2 of the 3 locationally oriented subjects in the second started their recalls by beginning their mental walks around the perimeter of department's main office location from the vacant office where the interview took place.



*Testing serial order explanations of associative patterning*

I now consider other explanations for the associative patterning that do not rely directly on the concept of work proximity. The first rival hypothesis posits that free recall subjects' recalls were driven only (or largely so) by a serial order process based on persons' statuses, since status was the primary factor involved in subjects' serial order patterns. If subjects tended to recall higher status persons in the beginning and lower status persons towards the end of recall, then any associative patterns related to work proximity might have arisen as a byproduct of this serial order pattern.

I tested this hypothesis by first simulating 30 recall paths that displayed frequency and serial order patterns similar to those observed in the subjects' observed recalls from the first interview. The persons in a simulated path were selected probabilistically from the set of all 23 persons according to the proportion of subjects in the first interview who recalled each person. The output serial positions of persons selected in a simulated path were determined probabilistically according to status (see Appendix A for a full description of the simulation process). The mean number of persons in the 30 simulated paths was 16.5. The mean gamma correlation between persons' output serial position and status in the simulated paths was 0.44 (range: 0.77 to 0.19). Thus, the simulated paths, which were produced by a status-oriented serial order recall process, closely matched the subjects' observed recalls in terms of frequency and serial order patterns. These 30 simulated paths were tested for clustering by work proximity in the manner described earlier. Fifteen of the 30 paths were more clustered than expected by chance, and the median Monte Carlo $p$ value was 0.4939 (range: 0.0152

to 0.9817, 2/30 paths $p < 0.05$). Obviously, then, a status-oriented serial order recall process does not contribute at all to the highly significant clustering by work proximity observed in subjects' recalls.

The second rival hypothesis postulates that alphabetically directed subjects' recalls were driven only (or mainly so) by a serial order process based on the alphabetical order of persons' first names, since alphabetical order was a major factor involved in these subjects' serial order patterns. This hypothesis was tested in exactly the same way as the status serial ordering hypothesis (see Appendix A for additional details). The mean number of persons in the 30 simulated paths was 16.7. The mean gamma correlation between persons' output serial position and alphabetical position in the simulated paths was 0.28 (range: –0.02 to 0.55). Therefore, these simulated paths, which were generated by an alphabetically-oriented serial order recall process, strongly resembled the alphabetically directed subjects' observed recalls in terms of frequency and serial order patterns. When these 30 simulated paths were tested for clustering by work proximity, only 14 of the 30 paths were more clustered than expected by chance, and the median Monte Carlo $p$ value was 0.6124 (range: 0.0519 to 0.9745). Plainly, the highly significant clustering by work proximity observed in alphabetically directed subjects' recalls was not due in any way to an alphabetically-oriented serial order recall process.

### *Other evidence for work proximity and status as fundamental organizational factors in recall*

Subjects' spontaneous, unprompted comments about their recalls and responses to other tasks also shed light on how they organized persons in memory. One subject succinctly summarized how she recalled persons at the end of an interview: "I did it hierarchically and said [department director's name], the director, and then went by the groups." I asked, "What groups are those?" and she responded "The [media relations people]. . . . the work groups." She then pointed out that she thinks about others in the office in terms of hierarchy and work groups. In doing the work proximity pile sort task, another subject volunteered the following remark which suggests that persons' work proximity to him led to their salience in his mind: "I tend to organize my thoughts about other people by familiarity, in terms of how much I work with them. I think about my own realm." Still another subject, while performing the socializing proximity ego ranking task, indicated the greater significance of work relations over socializing: "I just never look at most of these people that way. It's all work, work, work." This view was echoed by other subjects while performing socializing proximity tasks and is supported by the greater density of the work proximity matrix (0.26) in comparison to the socializing proximity matrix (0.14).



Moreover, in the second interview, all alphabetically directed subjects reported difficulty with the task. Also, 9 of the 13 subjects in the first interview mentioned at least one person's work section or role (e.g., media relations, publications, director, artist, student assistant, etc.) along with the person's name. Four of these subjects made extensive references to the work section/role of individual persons and/or clusters of persons in addition to giving persons' names, even though recall instructions simply asked for persons' names.

Furthermore, two subjects had one case each of misnaming a person's last name and these errors were related to social structural factors. Both misnamings involved a different boss – subordinate pair of persons who worked closely with each other. For each of these subjects, the proportion of work proximity link values among the persons recalled which were as large or larger than the work proximity link for the pair involved in the misnaming were 0.03 and 0.10, respectively. In each case, the subject who committed the misnaming error was not in the same work section as the pair of persons involved in the misnaming. Person confusion errors have previously been shown to be patterned by social relations (Fiske 1993; Fiske, Haslam, and Fiske 1991).

## DISCUSSION

Subjects shared a common cognitive structure of persons that was based on the department's work network and status hierarchy. Work proximity was the predominant and general associative factor in subjects' recall of persons. The IRTs for adjacently recalled persons confirmed the influence of work proximity on association in recall. Subjects' frequency patterns showed that the most visible persons were the most likely recalled. In addition, higher status persons and persons with whom the subject worked more closely were named earlier in recall than lower status persons and persons with whom the subject did not work closely. The status serial order pattern, however, did not account for the highly significant clustering by work proximity.

The patterns in the recall of persons were quite stable across interviews for those subjects who were interviewed twice, as Brewer (1993) also found. Alphabetically directed subjects were only partially successful in recalling persons in alphabetical order by the first letter of persons' first names. This result and subjects' spontaneously acknowledged difficulty with the task imply that subjects did not have an alternate organization of persons in terms of an alphabetical index of their names. They did show, however, virtually the same recall patterns as free recall subjects, although their associative and serial order results were somewhat weaker. The alphabetical serial ordering in these subjects' recalls could not explain either the clustering by work proximity or the status serial ordering. Regardless of

whether an alphabetical recall strategy is imposed on subjects (as in this study) or adopted by subjects voluntarily (as with two of Brewer and Yang's (1994) subjects), subjects' recall processes still seem to be affected (or even limited) by the organization of the underlying cognitive structure.

The negative relationship between work proximity and IRT throughout the course of recall bolsters the notion that the department's work network served as the primary basis for subjects' cognitive structure of department employees. In previous research on the recall of persons, temporal patterns have reflected the clustering results. Bond and associates (Bond *et al.* 1985; Bond and Brockett 1987) found that in subjects' recalls of acquaintances, IRTs were shorter within social context clusters than between social context clusters. Similarly, Brewer (1994) showed that in subjects' recalls of fellow graduate students, IRTs were shorter within cohort clusters than between cohort clusters. The logarithmic form of the work proximity – IRT relationship in the current study mirrors a very similar observation by Brewer and Yang (1994). They found that the mean Pearsonian correlation between social proximity and log IRT for adjacently recalled pairs of persons was –0.49, which compares with the mean work proximity – log IRT correlation of –0.63 in the present study. Both of these results correspond to Romney, Brewer, and Batchelder's (1993) predictions about the function relating IRT to semantic similarity in the free recall of lexical items from homogeneous semantic domains. Moreover, even the temporal patterns in the locationally oriented subjects' recalls were influenced by work proximity, which further suggests that work proximity was the fundamental associative factor for all subjects, no matter what recall strategy they used.

This study provides additional compelling evidence for the social structural basis of the organization of persons in memory. The findings from the present study, Bjorklund and Zeman (1983), Brewer (1993), Brewer and Yang (1994), and Williams and Hollan (1981) all suggest that persons in a socially bounded community are organized in community members' memories according to the community's social structure, and not persons's personality characteristics, as Bond and Brockett (1987) have asserted. Bond and Brockett (1987) showed that when recalling acquaintances, subjects clustered persons by the social context (community) in which they had interacted with persons. They observed that *within* clusters of persons from the same social context, subjects weakly clustered persons according to personality traits and that temporal patterns reflected this personality subclustering. However, persons' similarity in terms of personality traits and other individual characteristics tends to be modestly positively correlated with social proximity in socially bounded communities (Arabie 1984; Breiger and Ennis 1979; Iannucci 1992). Therefore, it might be that weak (and spurious) clustering by personality could be observed even when subjects are actually associating by some aspect of a community's social structure. It remains for future work, however, to ascertain the relative merits of social structural, personality, and other (Fiske this issue) explanations of the organization of persons in memory.



Persons' salience in this study was described by their visibility (for frequency patterns) and status and work proximity to the subject (for serial order patterns). Previous research has also shown that persons' visibility in a community (whether measured by regularity of physical presence or centrality of social position) is positively related to persons' frequency of mention (Brewer and Yang 1994; Freeman *et al.* 1987; Jennings 1937).

Persons' salience was further characterized by both community-centered (status) and ego-centered (work proximity to the subject) factors as revealed by the serial order patterns. Brewer and Yang (1994) reported a result somewhat analogous to status serial ordering. They found that persons in the religious fellowship who were more visible, in terms of centrality in the fellowship's social network, tended to be recalled earlier than less visible persons. Conceptually speaking, centrality in an egalitarian community like the religious fellowship might be considered a cousin of status, given the relationships between centrality and power in a wide variety of settings (Krackhardt and Brass 1994). Furthermore, Brewer (1993) observed serial order patterns that resembled the work proximity to a subject serial ordering in this study. In that study, subjects tended to recall persons who were in cohorts chronologically close to themselves earlier in recall than persons in distant cohorts. Hence, there appears to be a small set of basic variables, including visibility, status/dominance, and social structural proximity to a subject, which contribute to the salience of community members in the minds of individual community members.

Freeman (1992: 126) noted that ". . . all the individuals involved in any particular community would be expected ultimately to produce very similar mental images of group structure in that community." The results from the present study suggest that it is precisely this shared cognitive representation of a community's social structure that serves as individuals' cognitive structure of *persons* in the community. Further research that includes developmental and additional cross-cultural studies will help determine the universality of these social structural influences on person memory.

## APPENDIX A

The following paragraphs detail the status- and alphabetically-oriented serial order recall processes used in simulating paths (this framework was first presented in Brewer and Yang 1994). In generating a simulated path, the persons to be included in that simulated path are first selected probabilistically according to the proportion of subjects in the first interview who

recalled each person. Then, the output serial positions for the persons selected for a simulated path are determined probabilistically *for each successive output serial position*. Given the $n$ persons selected for a simulated path, the probability that a person $i$ who has not yet been output will be output next is

$$\frac{f_i g_i}{\sum_{i=1}^{n} f_i g_i}$$

where $f_i$ is person $i$'s status (relative alphabetical position), and $q_i$ equals 1 if person $i$ has not yet been output and 0 otherwise. Thus, this process is Markovian since the probability of any person being output next is independent of the order of persons output previously. This sampling process is also without replacement because a person could only be output once.

When persons' ordinary status and alphabetical position ranks were used in this simulation process, the serial order patterns (i.e., the correlations between output serial position and status/alphabetical position) in the simulated paths were not approximately the same as those in subjects' observed paths. By transforming (i.e., raising to a power) persons' status and alphabetical position ranks, I was able to produce simulated paths which displayed serial order patterns almost identical to those observed in subjects (see text).

## NOTE

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# Detecting Context-Based Constraints in Social Perception[1]

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ABSTRACT: This paper outlines a procedure for detecting context-based constraints in social perception. Specifically, this research examines how formal organizational structure can impact informants' reports of social relations. Twenty-three personnel from a regional accounting firm were asked to report their social relations. Observations of the individuals' interactions also were collected as an independent measurement source. Comparisons of the perceptual data with the formal organizational structure show reciprocated reports are significantly correlated with status similarity. Individuals who share the same rank in the organizational hierarchy mutually name one another to a greater extent than those in different ranks. Unreciprocated reports that are not observed are explained by the hierarchical nature of the status structure in that individuals of lower status tend to report ties with those in higher statuses but not vice versa. Unreciprocated reports of interaction that are observed, however, are not associated with the organizational structure. Instead, they are explained by differences in the size of informants' networks. Individuals with large networks tend to name ties that are not reciprocated. Apparently, in contexts where positional differences are pronounced, status is one of the main influences in social perception.

KEY WORDS: social perception, contextual constraints, network analysis, status, reciprocity

## DETECTING CONTEXT-BASED CONSTRAINTS IN SOCIAL PERCEPTION

Over the years various data collection methods have been developed in the social sciences. Yet, most social scientists collect and examine only one type of data. Whether through interviews or surveys, the most common way researchers gather information about social behavior is to *ask* informants about their experiences. Thus, much of our knowledge of human social behavior is based on informants' reports.

While collecting informants' reports is a relatively quick and easy way to obtain information, interpreting the data rarely is a straightforward operation. Difficulties in interpretation follow from attempts to verify reported data with other sources of information. When informants' reports are compared with observations, discrepancies routinely are discovered (Deutscher 1973). This finding was illustrated in a series of studies conducted by Bernard and colleagues (Bernard and Killworth 1977; Killworth