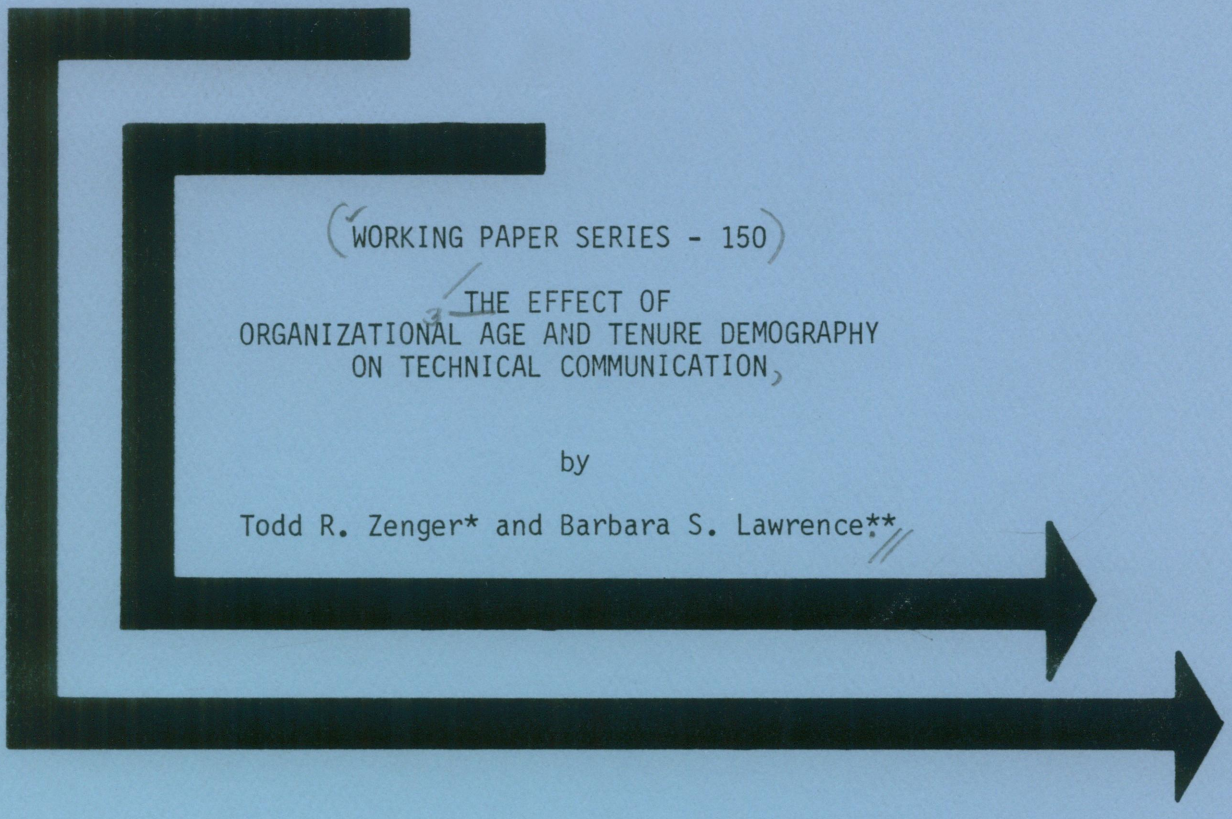

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THE EFFECT OF ORGANIZATIONAL AGE AND TENURE DEMOGRAPHY ON TECHNICAL COMMUNICATION

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ABSTRACT

Studies of technical communication in research and development settings consistently find a relationship between the frequency of technical communications and engineering performance. However, aside from studies of task characteristics and physical proximity, little research exists on what determines technical communication. Although organizational demography has been proposed as an important determinant of communication, this relationship has not been tested directly. Further, distinctions between the impact of different demographic variables on communication have not been explored. In this paper, we examine the association between age and tenure demography and technical communication within a research and development organization. In addition, we propose and test hypotheses concerning the differential impact of these demographic variables on technical communication inside and outside project groups.

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Studies of technical communication in research and development settings consistently find a relationship between the frequency of technical communications and engineering performance (Allen, 1970, 1977; Ebadi & Utterback, 1984; Menzel, 1965; Pelz & Andrews, 1976 [1966]; Tushman, 1978; Robertson et al., 1972). However, aside from studies of task characteristics and physical proximity (Barnlund & Harland, 1963; Hackman, 1968; Katz & Tushman, 1979; Tushman, 1978), limited evidence exists on the determinants of technical communication. Pfeffer (1981; 1983) recently proposed that an organization's demographic composition influences communication patterns because people tend to communicate with those who are similar to themselves. Thus, the demography of research and development organizations may be an important determinant of technical communication.

Although organizational demography has been linked to a variety of important outcomes such as turnover (Wagner, Pfeffer, & O'Reilly, 1984), and superior/subordinate relationships (Tsui & O'Reilly, 1986), we know little about the direct connection between demography and communication frequency. O'Reilly and Caldwell's (1986) recent examination of the relationship between demography and employees' perceptions of work group integration supports the existence of this connection. However, this study does not directly assess communication frequency. Further, to the authors' knowledge, theoretical and empirical work in organizational demography has not examined the potentially differential effects of various demographic variables on communication frequency. Organizations are generally characterized as homogeneous or heterogeneous utilizing either a single demographic variable or some set of demographic variables. Yet, there is no a priori reason to believe that age, race, or tenure demography exert the same influence on communication frequency.

This paper serves two purposes. First, we examine directly the relationship between age and tenure demography, the two most frequently discussed demographic variables,

and communication frequency. Second, we propose and test hypotheses concerning the differential impact of these variables on communication inside and outside project groups. Based on relational data collected from a U.S. electronics firm, the results confirm a relationship between demographic variables and the frequency of technical communication. The results also show that age demography exerts a greater impact than tenure demography on the frequency of technical communication inside project groups, while the reverse relationship holds for technical communication outside project groups. Finally, the implications of these results for demographic research in organizations are discussed.

THEORY

Organizational Demography, Technical Communication and Performance

Oral communication with individuals inside and outside project groups is the primary medium through which engineers and scientists transfer technical information (Allen, 1977; Menzel, 1965). Such communication permits individuals to synthesize complex ideas rapidly and to supply one another with immediate feedback. Thus, this method of communication provides a particularly efficient medium for the transfer of information and ideas (Mintzberg, 1973; Myers & Marquis, 1969; Tushman, 1978). Not surprisingly, numerous studies confirm a relationship between oral communication and project performance in R&D laboratories (*cf.* Allen, 1970; Katz, 1982; Pelz & Andrews, 1976 [1966]; Rubenstein, Chakrabarti, O'Keefe, Souder, & Young, 1976). Although the exact nature of the relationship between this mode of technical communication and project performance depends on factors such as the task and project type (Chakrabarti & O'Keefe, 1977; Katz & Tushman, 1978; Tushman, 1978), studies generally agree that frequent communication by at least some project group members both inside and outside the project group is vital to project performance. Frequent communication inside a

project group enhances the group's capacity to process information (Duncan, 1973; March & Simon, 1958; Tushman, 1978). And, frequent communication by at least some project group members with a relevant and diverse set of individuals outside the project group enables the transfer of new ideas and information (Ebadi & Utterback, 1985; Robertson et. al., 1972).

This positive association between technical communication and project performance indicates the importance of designing internal structures in research and development organizations that facilitate technical communication. Pfeffer (1981; 1983) suggests that the distribution of employees in an organization along some demographic dimension such as age, tenure, or gender influences communication patterns, and thus produces important organizational outcomes such as turnover. In universities, for example, time gaps between adjacent faculty hires create "lumpy" tenure distributions. When these gaps increase, communication between different tenure groups becomes more difficult, thereby isolating particular groups, encouraging conflict and power struggles, and hence encouraging higher levels of voluntary turnover (McCain, O'Reilly, & Pfeffer, 1983). As a result, the relationship between an organization's demography and communication may play an important role in project group performance.

If organizational demography does influence communication patterns, then the demographic attributes of organizations, because they are easily measured, may provide project and human resource managers with a useful tool for facilitating performance in research and development organizations. Yet, although O'Reilly and Caldwell (1986) provide evidence that demographic similarity in organizational tenure is related to social integration, to our knowledge, a direct evaluation of the relationship between demography and communication frequency has not been conducted. The primary purpose of this paper is to address the question: Is there a relationship between the distributional characteristics of an organization and the frequency of technical communication? In

examining this question, we present a theoretical rationale for the relationship, outlining the expected effects of age and tenure demography on technical communication frequency inside and outside project groups.

Communication Frequency and Demography: Age and Tenure

March and Simon (1958) propose that the frequency of communication between two employees increases with the efficiency or ease of communication. Related research suggests that the efficiency of communication is determined by the relative presence of a shared language or coding scheme (Allen & Cohen, 1969; Dearborn & Simon, 1958; Katz & Kahn, 1966; Newcomb, 1953; Runkel, 1956; Triandis, 1960; Tushman, 1978). A shared language among members of a group reflects their similar interpretations, understandings, and responses to information. Individuals unfamiliar with this shared language are likely to distort and misinterpret information received from group members and thereby to find communication with group members difficult (Barnlund & Harland, 1963; Rogers & Bhowmik, 1971).

Within organizations, the development of a shared language between employees results, at least in part, from their similar backgrounds and experiences. The experiences employees share inside organizations produce a common vocabulary and interpretations of events that facilitate work-related communication (Allen & Cohen, 1969; Lawrence & Lorsch, 1967). Employees' shared familiarity with a successful and previously-completed project, for instance, contributes to a common vocabulary and understanding of current work. In contrast, the background and experiences employees share outside organizations, by influencing employee attitudes, interests, and beliefs (Rhodes, 1983; Ryder, 1965) create a shared language concerning a wide spectrum of non-work-related issues. For example, employees with children of the same age tend to have similar events occurring in their family lives that produce shared language, including its common vocabulary and

interpretations (Runkel, 1956; Triandis, 1960).

The work- and non-work-related communication patterns produced by these similarities are likely to persist because of the tendency for communication patterns to stabilize in organizations (Katz, 1980; March & Simon, 1958; Roberts & O'Reilly, 1978; Weick, 1979 [1969]). As two individuals communicate over time, they develop a form of language compatibility that is unique to them. Two employees may, for instance, share a common organizational experience that facilitates initial conversations. Yet, as these employees continue to converse, they quickly develop additional similarity in attitudes, language, trust, and experience that facilitate subsequent communication (Kiesler & Kiesler, 1969; Williamson, 1985). In addition to these acquired similarities and trust, continued communication among employees results in familiar and comfortable work patterns (Katz, 1982) and consequent feelings of security and confidence for those involved (Weick, 1979 [1969]). Hence, initial conversations triggered by a single shared experience or other common background produce over time a form of "shared social investment" that employees are reluctant to forfeit. As these social investments mount, communication patterns become increasingly stable.

Demographic attributes such as age, organizational tenure, education, occupation, and gender provide surrogate measures for the common experiences and background that shape language development. For instance, employees with different occupations often share few job-related experiences and thus develop very different occupational languages (Triandis, 1959). Similarly, employees of different gender often have very different social, educational, and work experiences. These differences in background and experience may result in language differences that constrain communication among employees of different occupations or gender. Thus, because demographic attributes produce shared experiences, and because shared experiences create language compatibilities, people who share demographic attributes are believed to communicate more frequently than those

who do not (March & Simon, 1958: 167; Pfeffer, 1983). Consequently, the degree to which an employee is demographically similar to others in an organization may be an important determinant of that employee's communication frequency within the organization. In this paper, we focus on the two most frequently examined demographic attributes within organizations: age and tenure.

Age. Employees of similar age, regardless of their expertise, status, or tenure in the organization, tend to have common non-work-related experiences. Ryder suggests that a group of individuals of similar age takes on "a distinctive composition and character reflecting the circumstances of its unique origin and history" (1965: 845). For instance, employees who were college students during the Vietnam war share memories of their experiences during those social upheavals that probably differ dramatically from the memories of older employees who watched these events on television. And, employees who grew up during the Depression remember the impact of that economic disaster on family life in ways that distinguish them from younger employees who have never experienced true financial need. In addition to such historically generated similarities, employees of similar age tend to share common non-work-related experiences because these individuals tend to be "on schedule" in their family lives (Lawrence, 1980). In other words, the youngest employees tend to be unmarried, while those who are slightly older tend to have just married and have young children. Middle-aged employees may have divorced, have grown children in college, and have parents who need special care, while older employees tend to look forward to quieter lives without dependents and with grandchildren.

These common non-work-related experiences of employees outside the workplace appear to produce shared attitudes, interests, and beliefs among employees of similar age inside the workplace. Research shows that employees of similar age tend to hold comparable attitudes, interests, and beliefs that distinguish these individuals from their younger and older colleagues (Rhodes, 1983). For instance, studies show a positive

association between age and job satisfaction (Hunt & Saul, 1975; Kalleberg & Loscocco, 1983). People tend to become more satisfied with work as they grow older, even when satisfaction is controlled for tenure, gender, occupational level, income, and education. Positive associations have also been reported between age and job involvement (Saal, 1978), and between age and commitment (Morris & Sherman, 1981), while a negative association has been reported between age and turnover intention (Mobley, Horner, & Hollingsworth, 1978). And, because these common attitudes, interests, and beliefs both produce a common language (Runkel, 1956; Triandis, 1960) and encourage communication (Byrne, 1969; Lazarsfeld & Merton, 1954; Rogers & Bhowmik, 1971), age similarity seems likely to enhance communication between two employees.

Although age similarity may produce similarity in general attitudes about work that facilitate communication, this attitudinal similarity is unlikely to have much direct bearing on conversations about technical work. Technical conversations are facilitated by a common technical language that is not directly related to similarity in age. Thus, age similarity is more likely to facilitate non-technical discussions at work. Nevertheless, the self-reinforcing nature of communication links (Homans, 1950; March & Simon, 1958) implies that the communication channels produced by these non-work-related conversations will also influence the ease of work-related communications. Employees may, for instance, initially converse about common interests outside the workplace. However, once these individuals establish this communication channel, they may also utilize the channel for technical communication. Thus, although age similarity has its most direct effect on informal, non-work-related communication (Lincoln & Miller, 1979), it also has an indirect effect on more formal technical communication. Therefore, we expect that *employees who are relatively similar to others in terms of age will communicate more frequently about technical issues than employees who are relatively dissimilar.*

Tenure. The employees of most organizations develop their own unique and commonly shared language that facilitates communication about work-related issues (Allen & Cohen, 1969; Guetzkow, 1965; March & Simon, 1958; Williamson, 1975; 1985). Since employees acquire familiarity with this language largely through their experiences in the organization, the length of time an employee has worked in an organization is a useful indicator of an employee's organizational language skills. Greater tenure in the organization provides employees with an understanding of organizational policies and procedures and an understanding of the way work is accomplished. Thus, because tenure functions as an indicator of organizational experience, tenure also functions as an indicator of familiarity with the organizational language (March & Simon, 1958). Further, since employees similar in tenure are likely to share common language skills, an employee is likely to find communication most efficient with other employees either of similar tenure or of greater tenure. But, since employees of greater tenure will also find communication most efficient with other employees of similar or greater tenure, communication among employees of similar tenure is most likely to be reciprocated.

Communication in organizations may also be concentrated around employees of similar tenure for reasons other than language similarity. Assume for the moment that existing communication patterns in an organization are randomly determined, are thus independent of tenure, and through social investments have stabilized over time. A cohort of individuals entering this setting with a strong desire to establish communication links has two options. One is to establish ties with employees who already have deeply entrenched communication networks (Wagner et al., 1984). Two is to establish ties among themselves. Penetrating established communication networks is difficult for new employees. This activity disrupts current networks (Roberts & O'Reilly, 1979), and hence threatens to destroy the value of social investments inherent in these networks for longer-tenured employees. On the other hand, because all new entrants share the need

to develop communication links, new entrants will find it relatively easy to communicate with other new entrants. Therefore, because of similarity in organizational language and the presence of social investments, we expect that *employees who are relatively similar to others in terms of their organizational tenure will communicate more frequently about technical issues than employees who are relatively dissimilar.*

Technical Communication and Demography: Inside and Outside Project Groups

In the preceding discussion, we argue that an organization's age and tenure distributions exert a systematic effect on technical communication: as demographic similarity increases, technical communication should increase. However, technical communication differs inside and outside project groups. Communication inside project groups generally involves communication with other employees who are close in proximity, collaborate daily on project tasks, and are supervised by the same individual. In contrast, communication outside the project group yet within the organization generally involves communication among employees who do not collaborate daily on project tasks, are physically distant from one another, and are supervised by different individuals. In this section, we propose that while age and tenure similarity both contribute to the frequency of technical communication, their contribution differs inside and outside project groups.

Two assumptions guide our hypotheses concerning the effects of age and tenure similarity on technical communication. First, because tenure similarity directly facilitates work-related, technical communication, and age similarity only indirectly affects technical communication through non-work-related communication, tenure similarity is likely to exert a stronger influence on technical communication than age similarity.

Second, the effect of tenure similarity on technical communication frequency should diminish over time.[1] Because individuals enter organizations relatively uninformed, they have strong incentives to develop the language skills that facilitate effective

communication. As a result, employees make the most rapid gains in language skills during an initial socialization period. However, after employees learn the basic language skills, further gains in language development make less dramatic differences in each employee's ability to communicate effectively. Thus, language differences associated with differences in tenure are likely to diminish over time. For example, when two employees have been in an organization one and four years, respectively, a difference of three years of organizational experience between them may substantially impede communication. However, ten years later, substantial language differences between these employees may not exist and therefore their three years difference in organizational experience may exert no effect on communication. Thus, although tenure similarity influences technical communication frequency more directly than age similarity, the effect of tenure similarity diminishes over time, whereas the effect of age similarity does not. As will be evident in the discussion below, the speed with which the effects of tenure similarity diminish depends on the organizational setting in which the communication occurs.

Using these two assumptions, we now derive hypotheses concerning the relative effects of age and tenure similarity on technical communication frequency among employees both inside project groups and outside project groups.

Inside Project Groups. The impact of tenure similarity on technical communication is likely to diminish rapidly within project groups. The typical engineering project involves considerable interdependence of project members. This creates strong incentives for current members to help new members quickly overcome language and skill deficiencies that impede the group's performance. In addition, the relatively small number of employees inside project groups produces a high density of communication (Collins & Guetzkow, 1964), and thereby further facilitates the speed with which new members develop work-specific language skills. As a result, new members are assimilated rapidly inside project groups and their levels of technical communication inside project groups

do not differ from the communication levels of their more senior colleagues (Lee & Allen, 1982). Hence, location inside project groups minimizes the effect of tenure similarity on technical communication. Thus, it seems likely that *the age similarity of project group members exerts a greater impact than their tenure similarity on the frequency of technical communication inside project groups.*

Outside Project Groups. While the impact of tenure similarity on technical communication outside project groups should also diminish over time, it is unlikely to diminish as quickly as inside the work group. Employees in different project groups tend to be much less interdependent than employees within the same group. Consequently, it seems likely that long-tenured employees have fewer incentives to teach new employees in other project groups the required language skills to communicate effectively outside their project groups. Moreover, the relatively low density of communication outside the project group means that the requisite language and skills for communicating outside the project group are likely to develop rather slowly. Thus, the association between tenure and outside-the-work-group language skills is likely to persist longer than the association between tenure and inside-the-work-group language skills. Therefore, given that in general, tenure similarity exerts a greater impact on technical communication than age similarity, *the tenure similarity of employees outside the project group should exert a greater impact than their age similarity on the frequency of technical communication outside project groups.*

METHOD

Data

Data for this study were obtained from the population of engineers and engineering managers in a research division of a medium-sized U.S. electronics firm. The division is geographically isolated from the rest of the firm, and primarily conducts development

work, as opposed to basic research or technical service projects (cf. Katz & Tushman, 1979). The division, hereafter to be referred to as the organization, has nineteen project groups ranging in size from three to nine members. The average age of engineers and engineering managers is 39 (S.D. = 9.8, Range = 26–65), and their average tenure is 5.7 years (S.D. = 5.3, Range = 0–24). The organization has a dual-track engineering/management career that includes nine levels. Questionnaires were distributed to the organization's 92 engineers and engineering managers. Nearly all questionnaires were returned (N = 88, 96%). In addition, demographic data on these 92 employees were obtained from the company's personnel records.

Measures

Technical Communication Frequency. Technical communication frequency inside and outside of project groups was obtained from employees' responses to the relational question: How often do you discuss technical issues you face in your work with each person on this list? To answer this question, employees were provided with a list of all research and development engineers and engineering managers in the organization. Then, using a 5-point Likert-type scale ranging from "never" to "roughly every day," employees indicated the frequency with which they discuss technical issues with each employee on the list. Because employees may over- or under-report the frequency of their communications with others, both communication measures were computed using the average frequency of communication that others indicate speaking with the employee. Measured in this manner, differences in question interpretation and response patterns across employees exert a similar effect on each employee's technical communication value.[2]

Technical Communication Inside the Project Group is defined as the average frequency project group members indicate communicating with the employee. Thus, if Mary is in a project group of four employees, Mary's technical communication inside the project group

is measured by taking the relational responses of the other three employees in her project group, and computing the average frequency with which these employees indicate they communicate with Mary. The ten employees who participate in two project groups were included twice in the *Inside Project Group* analysis; once for each project group.

Technical Communication Outside the Project Group is defined as the average frequency non-project group members indicate communicating with the employee. Thus, if Bob is in a project group of four employees, Bob's technical communication outside the project group is measured by taking the relational responses of the 88 employees who do not belong to his project group, and computing the average frequency with which these employees indicate they communicate with Bob.

Age and Tenure Similarity. The measures of demographic similarity are those used by Wagner, Pfeffer, and O'Reilly (1984), except that we have changed the sign of each measure for ease of interpretation. Thus, an employee's similarity to other employees in his or her comparison group increases rather than decreases with the value of these measures. When the comparison group is the organization, employees receive a value that represents their age or tenure similarity to a subset of ten organization members where these ten employees are chosen to minimize this value.[3] Age and tenure similarity *within the organization* will be distinguished by the superscript "O," e.g., age similarity.^{O} When the comparison group is the project, employees receive a value that represents their age or tenure similarity to other members of the project group. Age and tenure similarity *within project groups* will be distinguished by a superscript "G," e.g., tenure similarity.^{G}

Age and Tenure Similarity Within the Organization are defined as

$$D_i^O \equiv -\min_{S_n \subset O}\left[\frac{1}{n-1}\sum_{j\neq i\in S}(x_i - x_j)^2\right]^{\frac{1}{2}},$$

where D_i^O is the age or tenure similarity for employee i, S_n is any subset of n employees

in the organization O, and x is an employees's age or tenure.

Age and Tenure Similarity Within Project Groups are defined as

$$D_i^G \equiv -\left[\frac{1}{n-1}\sum_{j\neq i\in G}(x_i - x_j)^2\right]^{\frac{1}{2}},$$

where D_i^G is the age or tenure similarity for employee i within project group G, n is the number of employees in G, and x is an employee's age or tenure.

Career Level is defined as an employee's position on the organization's engineering/management hierarchy.

Project Group Size is defined as the number of employees within each project group.

Table 1 provides the means, standard deviations, and correlations of the measures used for the *Inside Project Group* and *Outside Project Group* analyses.

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Insert Table 1 About Here

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Control Variables

Several control variables are important for this study. First, we control for the direct effect of organizational tenure on technical communication. As an employee's organizational tenure increases, interpersonal relationships develop and opportunities to speak with others increase, therefore technical communication should increase. Thus, an employee's tenure may influence technical communication independent of his or her similarity in tenure to others in the organization. Second, we control for the effect of career level on technical communication. As employees advance to higher career levels, the task characteristics of their jobs may require more frequent communication. Further, an employee's career level influences technical communication through the impact of formal hierarchy on status and interaction channels (Homans, 1974 [1961]; Lincoln &

Miller, 1979). Finally, we control for the effect of project group size on technical communication inside the project group. As the size of a project group increases, other effects being held constant, the average technical communication for each project group member should decline (Thomas & Fink, 1963).

We do not control for age, gender, education, or the effect of project group size on technical communication outside the project group. The literature suggests that age influences communication; however, the explanation for this relationship is not chronological age *per se* but demographic similarity. For instance, the more similar people are in age, the more likely they are to hold similar attitudes, interests, and beliefs, and thus the more likely they are to communicate with one another (Riley, Johnson, & Foner, 1972; Ryder, 1965). In addition, age confers status to individuals within groups and these status differences influence communication; thus, age dissimilarity influences communication (Baker, forthcoming). Because these explanations are captured directly by the age similarity measure used in our study, it is unnecessary to include age as a separate control variable.[4] The proportion of women in an organization is also believed to influence communication frequency (cf. Kanter, 1977; Spangler, Gordon, & Pipkin, 1978). However, there are only four women (4.3%) in this organization. This number is so small that gender seems unlikely to exert a major impact on the results.

Allen (1967) shows that educational similarity influences communication frequency. For instance, engineers with advanced degrees tend to talk more frequently with others who hold advanced degrees than with those holding a college education. However, a comparison of the technical communications of two educational groups in the organization studied here shows no significant differences in communication frequency by educational level. Engineers holding educational levels up to and including a bachelor's degree do not differ significantly in their average communication frequency with others of similar education and their communication with graduate-educated engineers ($t = .89$

df = 78). In addition, graduate-educated engineers do not differ significantly in their average communication frequency across these two groups (t = .88 df = 70). Finally, project group size may influence technical communication outside the project group if the variation in project group size is large relative to the organization's size. That is, as project group size increases, the number of people outside the project group decreases, thus the number of external people with whom a project group member may communicate decreases. However, the correlation between project group size and technical communication outside the project group is not significant (ρ = .12, p = n.s.). Thus, project group size was not included as a control variable in the *Outside Project Group* analysis.

RESULTS

Inside Project Group Analysis: Table 2

The first equation in Table 2 includes only the control variables and shows that, as expected, project group size exerts a significant impact on technical communication inside project groups. As project group size increases, communication frequency decreases. However, neither of the other control variables, career level or organizational tenure, make a significant contribution to the explained variation in technical communication. Equations two through four, which include both the control and independent variables support the hypothesis that age similarity^G exerts a greater impact on technical communication inside project groups than tenure similarity.^{G} The age similarity^G coefficient is significant and in the expected direction, whereas the tenure similarity^G coefficient is not significant. The positive age similarity^G coefficient indicates that the smaller the age differences between an employee and the other employees in his or her project group, the more frequently he or she will communicate with them concerning technical issues.

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Insert Table 2 About Here

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To confirm that these results are not produced by the high correlation between age and tenure similarity^{G} (ρ = .497, p < .001), equations 2 and 3 show separate analyses for these variables. The stability of the coefficients and standard errors in each equation provides additional confidence in the equation 4 results. Even when assessed independently, age similarity^{G} maintains its significant relationship to technical communication whereas tenure similarity^{G} does not. Thus, it seems reasonable to accept the hypothesis that the age similarity^{G} of project group members exhibits a greater impact than their tenure similarity^{G} on the frequency of technical communication inside project groups.

Outside Project Group Analysis: Table 3

The first equation in Table 3 includes only the control variables and shows that, as expected, the control variables, career level and organizational tenure, exert a significant impact on technical communication outside project groups. As career level and organizational tenure increase, communication frequency increases. Equations two through four, which include the control and independent variables, support the hypothesis that employees who are relatively similar to others in terms of their age or tenure will communicate more frequently outside project groups about technical issues than employees who are relatively dissimilar.

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Insert Table 3 About Here

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Finally, the results presented in the fourth equation are consistent with the hypothesis that tenure similarity^{O} exerts a greater impact on technical communication than age

similarity^{O} outside project groups. Nonetheless, in comparing equations one, two, and three, the difference between the variation explained by tenure similarity^{O} and the variation explained by age similarity^{O} is not large. The positive age similarity^{O} coefficient indicates that for any employee and the ten people most similar to him or her in age, the smaller the age differences between them, the more frequently the employee communicates with others outside his or her project group. Further, this equation confirms a similar relationship between tenure similarity^{O} and technical communication. For any employee and the ten people hired within the closest time period to that employee, the smaller the time gaps in hiring, the more frequently the employee communicates with others outside his or her project group. Thus, both age similarity^{O} and tenure similarity^{O} contribute to the explained variation in technical communication outside project groups.

Additional Analyses. The high correlations among age similarity^{O}, tenure similarity^{O}, and organizational tenure raise potential multicollinearity problems with the outside of project group analysis. The coefficients and standard errors of these variables appear relatively stable across the equations in Table 3, thus providing some confidence in the results. However, we also performed several additional analyses to assess the potential impact of multicollinearity on the results.

An inspection of the distribution of the three correlated independent variables shows that the high correlations result primarily from a skewed organizational tenure distribution. Eighty-one employees have been with the organization for less than nine years, while the remaining eleven employees have been with the organization fifteen years or more (Range = 15–24). As a result, these eleven employees have high organizational tenure values and high tenure similarity^{O} values, and this largely accounts for the high correlations. Deletion of this employee group from the sample reduces the correlations as follows: age similarity^{O} and organizational tenure from $\rho = .43$ ($p < .001$) to $\rho = .17$ (p = n.s.); tenure similarity^{O} and organizational tenure from $\rho = .91$ ($p < .001$) to

$\rho = .27$ ($p < .05$); age similarity^{O} and tenure similarity,^{O} from $\rho = .42$ ($p < .001$) to $\rho = .08$ (p = n.s.).

A multiple regression analysis performed with the eleven high tenure employees deleted from the sample confirms the results shown in Table 3. A second analysis using the entire sample and the log of organizational tenure and tenure similarity,^{O} to reduce the distributional skew, also confirms the reported relationships. Finally, we utilized an analysis of covariance to control and test for differences between those employees with organizational tenure of less than nine years, and those employees with organizational tenure greater than or equal to fifteen years. None of the interaction terms are significant. Once again, the results confirm the relationships observed in the original multiple regression equations. These analyses suggest that the results reported in Table 3 are not an artifact of multicollinearity.[5] Thus, it seems reasonable to accept the hypothesis that the tenure similarity of employees exerts a greater impact than their age similarity on the frequency of technical communication outside project groups.

DISCUSSION

The results of the study presented in this paper show a relationship between organizational demography and technical communication frequency. The findings thus support the use of demographic variables as surrogates for communication frequency in organizational research. Indeed, the seemingly large portion of variation in technical communication that can be explained with only a few demographic variables is encouraging. However, the data also confirm that we need additional theoretical and empirical work to explain the independent effect of different demographic variables on organizational outcomes. In this study, we show that age and tenure demography do not contribute equally to explaining the variation in technical communication inside and outside project groups. As predicted, inside project groups, the age similarity of

project group members exerts more influence on technical communication than their tenure similarity. The opposite relationship seems to hold outside project groups, where the tenure similarity of organizational members exerts more influence on technical communication than their age similarity.

These results suggest that the effects of tenure similarity are more sensitive to situational characteristics than the effects of age similarity. Tenure similarity is a significant predictor of technical communication in situations where shared work-related knowledge and skills do not develop rapidly and where employees share little incentive to assimilate new members. In organizations or large groups in which members have infrequent contact, the development of such knowledge and skills occurs relatively slowly. However, in small groups, shared work-related knowledge and skills develop rapidly and current members are more likely to disrupt current communication patterns to assimilate new entrants. As a consequence, in such settings tenure differences exert less influence on technical communication. These situational characteristics appear not to influence the impact of age similarity. Thus, the results are consistent with the interpretation that the effects of age similarity on technical communication result from basic social behaviors that occur independently of task characteristics.

The results from this study are limited in several ways. One limitation is that they are based on a single organization; thus, they cannot be generalized to other organizations. In addition, the project groups in this organization focus almost exclusively on development work. And, because project type influences communication patterns (Katz & Tushman, 1979), it is possible that the strength of the relationships between age and tenure similarity and technical communication differs in organizations with a different mix of technical service, development, and basic research projects. Another potential limitation is that sociometric measures do not always produce accurate measures of actual communication patterns (Bernard & Kilworth, 1977).[6] However, this criticism

applies to all past research on technical communication, and past research has measured "something" about the way engineers perceive their communications that is related consistently with performance. Thus, the correct interpretation of this relationship may not be that engineers' *actual* technical communication is associated with performance, but rather that engineers' *perceptions* of technical communication are associated with performance. For this reason, the correct interpretation of the results from our study may be that age and tenure similarity influence engineers' *perceptions* of technical communication.

This alternate interpretation suggests that the meaning of the relationship between project group size and technical communication inside project groups should be examined in more detail. If relational measures indicate engineers' perceptions of technical communication, then these perceptions are likely to influenced by standard decision making biases. Specifically, the availability heuristic (Tversky & Kahneman, 1974) suggests that employees are more likely to remember contacts with employees seen frequently than contacts with employees seen occasionally. Thus, the negative association between project group size and technical communication may result because an individual's project group includes employees the individual sees most frequently. The individual is most likely to remember communications with these employees, and, therefore, the frequency of "remembered" communications increases directly with the decreasing size of the individual's project group.

Another topic for additional research is the effects of organizational demography on communication-related organizational outcomes. For instance, one important area of inquiry is the relationship between organizational demography and R&D project group performance. Given the relationship between technical communication and project group performance (Allen, 1966, 1970; Ebadi & Utterback, 1984; Pelz & Andrews, 1976 [1966]), and given the positive relationship found in this study between demographic similarity

and technical communication, we would expect that demographically similar projects show relatively high rates of communication and thus relatively high performance. However, the important caveat to this hypothesis is that, as discussed earlier, project group type appears to determine the kind of communications necessary for high performance groups. And, in some cases, an overly homogeneous project group, by encouraging internal and discouraging external communications, might experience lower performance over time (Katz, 1982).

Finally, the distinction between different definitions of "demography" and the effect these definitions may exert on organizational outcomes should be examined. For instance, while Katz's (1982) work and ours both utilize demographic tenure measures, the conceptual meaning of these measures differs. Katz examines *group tenure*, defined as the average time project group members have worked together. The key dimensions of group tenure are short and long. Although the relationship is not linear, long tenured project groups tend to communicate less frequently than short tenured project groups. In contrast, we examine *organizational tenure similarity*, which represents the differences in organizational tenure among project group members. The key dimensions of this measure are similar and dissimilar. Project groups whose members are dissimilar in organizational tenure tend to communicate less frequently than project groups whose members are similar in organizational tenure.

The group versus organizational tenure distinction noted in footnote #1 provides the first important difference between Katz's group tenure measure and the organizational tenure similarity measure used here. A project group's characterization along the short–long dimension does not predict the group's characterization along the similar–dissimilar dimension. Members in a project group with short group tenure may be either very similar or very dissimilar in their organizational tenure. And, the size of these similarity differences must decrease as group tenure increases. Long group tenure requires that, on

average, the organizational tenure of group members must increase, which concatenates the possible range of tenure similarity. Thus, group tenure and organizational tenure similarity do not measure the same demographic concept.

Yet, even if we use a tenure similarity measure based on group rather than organizational tenure, the two measures still differ. For instance, when group tenure is either short or long, the group tenure similarity of project group members will tend to be relatively high. When group tenure falls between short and long, the group tenure similarity of project group members will tend to decrease. Regardless of whether an organizational or group tenure similarity measure is used, group tenure examines mean effects whereas tenure similarity examines distributional effects. These differences emphasize the importance of carefully defining demographic measures and considering the impact of their differences.

The relationship found in this study between organizational demography and technical communication suggests that demographic attributes may provide project and human resource managers with a useful tool for facilitating high performance in research and development organizations. On the project level, the results from this study suggest that diversity in organizational tenure may be an effective approach for designing project groups. Given the relative importance of external communication for project group performance, and the relative unimportance of tenure similarity in producing inside project group communication, this design has a number of advantages. Tenure diversity provides project groups with a set of diverse contacts outside the project group. In addition, the communication channels established between longer and shorter tenured employees inside project groups will probably spill over to contacts outside project groups. For instance, if Mary, a new employee, works on a project with Bob, a 20-year veteran, Mary will probably find it easier to contact Bob's friends outside the project group as a result of her association with Bob. Research shows that keeping such external

communication channels open facilitates project performance (Katz, 1982). Tenure diversity also provides good training for new employees. Inside project groups, longer tenured employees have strong incentives for getting new employees up-to-speed. Thus, the organization benefits because important work-specific knowledge and skills are passed on from one generation of employees to another.

Suggesting normative implications concerning age demography inside the project group is considerably more problematic. Although age homogeneity inside project groups may enhance technical communication, such similarity may simultaneously reduce the diversity of contacts outside the project group and thereby negatively affect project performance. In addition, age homogeneity within project groups may produce age norms that influence project group assignments (Lawrence, 1988). For instance, managers might assign only "older" engineers to challenging basic research projects because these projects have always been staffed by this age group. While such assignments produce age homogeneous project groups whose members are likely to communicate frequently, it also creates project groups defined by age statuses: only one age group gets assigned to the challenging, state-of-the-art projects engineers prefer. The frustration this differentiation is likely to produce among excluded engineers may encourage some to leave for more promising jobs and others to retire on the job (Lawrence, 1987). Thus, a balance between age and tenure homogeneity and diversity in human resource planning probably carries the most significant benefits for both employees and organizations.

On the organizational level, the results of this study suggest that demographic homogeneity enhances technical communication and thus may improve organizational performance. However, since an organization's demographic distribution is determined by year to year hiring and turnover patterns, altering demographic homogeneity, particularly in the short run, is problematic. In addition, it is not entirely clear what demographic distribution is optimal. Hiring large blocks of employees of the same age every few years

may encourage communication within these large cohorts, but at the same time create strong divisions between cohorts and severely isolate those not hired in peak years. A seniority-based layoff that removes entire cohorts of entrants may have a similar isolating effect as fluctuations in hiring. On the other hand, steady year-to-year hiring may avoid demographically-based divisions and limit the number of isolated individuals, but also restrict the high frequency of communication promoted by large cohorts. Clearly there is a need for additional research on the differing effects on communication of alternative demographics patterns. Nonetheless, managers should give greater attention to the long term communication-related effects of staffing decisions. This study suggests that staffing decisions made today influence the communication patterns of the organization, five, ten, perhaps twenty or more years in the future.

In summary, this research provides encouraging results for further study of demographic variables in organizations. Certainly we need to learn more about how and under what circumstances different demographic variables produce organizational outcomes. Further, we need to learn more about the processes that intervene between demographic characteristics and organizational outcomes. This study suggests that organizational demography produces at least one organizational outcome, performance, through the relationship between demography and technical communication. However, other intervening variables such as inter-cohort conflict, status differences, and social comparison processes may also be important. The many explanatory possibilities of such intervening variables in conjunction with the utility of demographic variables as managerial tools make organizational demography a topic of continuing interest.

FOOTNOTES

[1]This paper focuses on *organizational* demography. Thus, our interest is in the tenure distribution in the organization rather than the tenure distribution inside project groups. However, Katz (1982) provides an example of this time effect on the distribution of tenure inside project groups. His results show that group performance goes up until average group tenure reaches around five years, at which time, presumably, the shared language and coding schemes used by group members are so similar that new information or ways of looking at ideas have more difficulty making their way into the group, thus reducing group performance.

[2]The four subjects who did not return questionnaires are included in the analysis. For each employee in a project group with these subjects, the employee's self-reported communication with the subject is substituted for the subject's relational response. A *t*-test of communication frequency values shows no difference between employees whose values include self-reports and those whose values do not ($t = .02$, $df = 16$, $p = .98$). The same procedure was used to compute the outside project group communication measures.

Ten employees who returned questionnaires were not on the original list of employees. Although the questionnaire provides space for adding extra names, respondents did not have an equal opportunity to be reminded of their contacts with the ten additional employees. Consequently, for these ten individuals, self-indications of communication frequency with other employees were used in calculating the communication measures.

[3]Regression results using several different subset sizes were examined. The choice of subset size appears to exert little effect on the results (See also results of Wagner et al., 1984). We chose a subset of ten individuals because this seems a reasonable cohort size. Further, this cohort size can be used easily in other organizations for comparison

purposes. For instance, if we utilized the organization as the subset size, the similarity measures obtained in this study could not be compared directly with similarity measures obtained from a second smaller or larger organization.

[4]The only reason for specifying age as a control variable is if adults are known to communicate more frequently at one age than another. Thus, if 35 year-olds talk with others more frequently than 45 year-olds, then age would be an important control variable. However, to our knowledge, no theoretical statements or empirical results exist that suggest this relationship.

[5]The results of these additional analyses are available from the second author.

[6]While Bernard and Kilworth (1977) raise an important criticism, studies of the discrepancy between real and perceived communication frequency require more study. For instance, one of the several studies conducted by Bernard and Kilworth involves a group of deaf individuals and a comparison of their memories of teletype communications with their actual teletype communications. This seems a reasonable test of the inaccuracy hypothesis; however, we also know that people's interaction frequency and interaction content are influenced by the medium they use in communicating (Daft & Lengel, 1984). Thus, Bernard and Kilworth may be picking up differences in media use rather than differences in accuracy.

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TABLE 1

Means, Standard Deviations, And Correlation Matrices

A. Inside Project Group Analysis (N=102)

Measures	Mean	S. D.	Correlation Matrix 1	2	3	4	5	6
Technical Communication ..	2.751	.859	1.000					
Age Similarity^{G}	−11.813	5.063	.433***	1.000				
Tenure Similarity^{G}	−6.877	4.363	.303**	.497***	1.000			
Career Level	3.208	1.299	.174	.015	.001	1.000		
Organisational Tenure	6.060	5.730	−.251*	−.504***	−.684***	.107	1.000	
Project Group Size	5.632	1.968	−.611***	−.343***	−.357***	−.152	.194	1.000

B. Outside Project Group Analysis (N=92)

Measure	Mean	S. D.	Correlation Matrix 1	2	3	4	5
Technical Communication ..	.387	.189	1.000				
Age Similarity^{O}	−1.403	1.328	.039	1.000			
Tenure Similarity^{O}	−.759	1.325	−.186	.419***	1.000		
Career Level	3.143	1.313	.509***	−.137	−.133	1.000	
Organisational Tenure	5.668	5.344	.334**	−.433***	−.905***	.157	1.000

* $p < .05$, ** $p < .01$, *** $p < .001$.

TABLE 2

Determinants of Technical Communication Frequency
Inside Project Group Analysis (N=102)

Measures	Equations 1	2	3	4
Career Level	.071	.065	.071	.067
	.054[a]	*.053*	*.055*	*.053*
Organisational Tenure ...	−.023	−.009	−.024	−.013
	.012	*.014*	*.016*	*.017*
Project Group Size	−.245***	−.222***	−.246***	−.226***
	.036	*.037*	*.038*	*.038*
Age Similarity^G		.036*		.038*
		.016		*.017*
Tenure Similarity^G			−.001	−.010
			.023	*.023*
Constant	4.064	4.287	4.062	4.279
R^2	.41	.44	.41	.44
Adjusted R^2	.39	.41	.38	.41
F-Ratio	20.659***	17.392***	15.324***	13.827***

* $p < .05$, ** $p < .01$, *** $p < .001$.
[a] Standard errors in italics.

TABLE 3

Determinants of Technical Communication Frequency
Outside Project Group Analysis (N=92)

Measures	Equations			
	1	2	3	4
Career Level	.067***	.069***	.066***	.068***
	.015[a]	*.012*	*.012*	*.011*
Organisational Tenure ...	.009**	.013***	.030***	.033***
	.003	*.003*	*.007*	*.007*
Age Similarity[O]		.039**		.036**
		.013		*.012*
Tenure Similarity[O]			.094***	.088**
			.027	*.026*
Constant	.128	.152	.084	.108
R^2	.33	.39	.41	.46
Adjusted R^2	.31	.37	.39	.43
F-Ratio	21.325***	18.493***	19.833***	18.305***

* $p < .05$, ** $p < .01$, *** $p < .001$.
[a] Standard errors in italics.