Shadowing Networks:

A Field Experiment to Assess the Effects of Cross-Training on Workplace Networks[1]

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Abstract: This article assesses the effects of cross-training, a core element of the "high performance work" practices that have diffused broadly across firms, on workplace social networks. The author derives theoretical propositions about the effects of cross-training on the size and composition of workplace networks, the moderating role of individual differences in cognition about the self as a collaborative actor, and the differential effects of cross-training on the networks of male versus female participants. Semi-structured interviews with 40 past program participants and a longitudinal field experiment involving 91 participants in a cross-training program at a software development laboratory in China and 85 matched non-participants reveal that: (1) relative to non-participants, participants in cross-training reported an expansion in workplace networks; (2) the tendency to form bridging ties was amplified for participants with a more collaborative implicit self-concept; and (3) relative to males, female participants reported a greater expansion in workplace networks. These findings contribute to research on workplace practices and network change, cognition and social networks, and sex-based differences in workplace networks.

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There is by now a wealth of evidence linking the nature and quality of interpersonal networks within organizations to various indicators of individual attainment – for example, performance evaluations and rewards (Burt 1992), career mobility (Podolny and Baron 1997), the generation of valued new ideas (Burt 2004), and relative power and influence (Brass 1984). Yet despite the importance of networks for individual success, remarkably little is known about what organizational practices, if any, actually help employees build interpersonal connections and how these effects might vary across individuals and employee groups.

Recent years have seen the adoption by firms of a set of practices that should, in principle, spark the formation of internal network connections. In particular, a staggering proportion of firms have restructured their operations according to the principles of "high performance work" practices (Kalleberg, Marsden, Reynolds, and Knoke 2006; Osterman 2000). Central among these practices are cross-training programs, which are thought to expand and extend employees' workplace networks. For example, Kalev's (2009) study of the life histories of over 800 organizations reports that, after firms adopted cross-training and other programs designed to support cross-functional collaboration, ascriptive inequality declined. Kalev (2009: 1595) argues that these programs "create new opportunities for peerlike collaborative relations between workers from more- and less-valued jobs [and] can increase visibility and reduce the stereotyping of women and minorities." Similarly, in a study of the career consequences of job rotation – a form of cross-training – in a pharmaceutical firm, participating employees reported experiencing the benefit of "increased networks of contacts" (Campion, Cheraskin, and Stevens 1994: 1537). Yet the research designs of these studies did not permit direct observation of changes in interpersonal networks – a core mechanism through which cross-training programs are presumed to influence attainment and inequality.

The present study therefore has three primary objectives. First, the study aims to evaluate the effects of cross-training on workplace networks. In particular, I report the results of a longitudinal field experiment involving 91 participants in a cross-training program in a software development laboratory in China and a matched control sample of 85 non-participants. Supplemental qualitative analysis provides insight into the mechanisms through which cross-training can reshape workplace networks. Second, it seeks to identify how stable individual differences can influence program effectiveness. I focus on the role of a cognitive orientation – the implicit collaborative self-concept (Srivastava and Banaji 2011) – that has been associated with the propensity of individuals to form collaborative networks that bridge internal organizational boundaries. I examine how this orientation moderates the program's effects on bridging ties. Third, the study assesses the differential effects of cross-training on the workplace networks of males and females. The analyses reported below allow for such a comparison, while controlling for all time-invariant, unobserved individual differences among program participants.

THEORY

High Performance Work and Cross-Training Programs

Research on employment relations has documented the steady adoption by US firms of internal labor market innovations such as self-directed work teams, quality circles, and job rotation, and training programs (Black, Lynch, and Krivelyova 2004; Kalleberg, Marsden, Reynolds, and Knoke 2006; Osterman 1994). These innovations have been loosely termed "high performance work" practices, though the evidence about their link to organizational performance has been mixed (Cappelli and Neumark 2001; Kalleberg and Moody 1994). Among these practices, some are designed to increase the permeability of job boundaries and increase the exposure of employees to colleagues in other parts of the organization (Evans and Davis 2005). This investigation focuses on one such practice, cross-training – defined as "multiskilling programs that provide workers with knowledge of and experience in different jobs" Kalev (2009: 1600). Cross-training has diffused broadly across firms: by 2002, over 80% of the firm's in Kalev's sample had adopted this practice.

Cross-Training and Workplace Networks

In developing the argument about how cross-training can be expected to alter the workplace networks of participants, I draw the distinction between new tie formation and the activation of previously formed ties (Hurlbert, Haines, and Beggs 2000; Mariotti and Delbridge 2012; Srivastava 2012b). That is, just because a tie has formed does not mean it will remain active indefinitely; rather, many pre-existing ties become latent and remain so until one person activates the tie – that is, converts the latent tie into an active relationship. Cross-training can be expected to increase the stock of workplace networks by promoting new tie formation and the flow of resources through networks by stimulating tie activation. With respect to tie formation, the formal organizational structure is known to importantly constrain opportunities for contact and can thereby significantly shape tie formation (Blau 1977; Han 1996; Hinds and Kiesler 1995; Ibarra 1992b). By bringing people into contact with colleagues in different organizational subunits, cross-training will tend to expand the opportunity structure for interaction and thereby support new tie formation. Moreover, when cross-training occurs in the context of project teams or work groups, these collective units will serve as foci that further promote tie formation (Feld 1981). With respect to network activation, ties that span formal organizational boundaries are especially likely to remain latent because of the myriad barriers to cross-boundary collaboration – for example, the cognitive, or interpretive, differences that drive a wedge between formal subunits (Dougherty 1992). Cross-training promotes the formation of shared mental models about group interaction and facilitates inter-group coordination (Marks, Sabella, Burke, and Zaccaro 2002). Thus, participants in cross-training will be more likely to activate latent ties, particularly those that bridge formal organizational boundaries. Taken together, these

arguments lead the baseline hypotheses about cross-training and workplace networks: **Baseline Hypothesis A: Relative to non-participants, participants in cross-training will report activating a larger number of workplace ties. Baseline Hypothesis B: Relative to non-participants, participants in cross-training will report activating a greater proportion of bridging ties.**

Implicit Collaborative Self-Concept and Bridging Ties

In recent years, network researchers have identified a range of individual-level factors that are associated with the tendency to form particular kinds of interpersonal connections. Examples of these attributes include: self-monitoring (Mehra, Kilduff, and Brass 2001; Oh and Kilduff 2008; Sasovova, Mehra, Borgatti, and Schippers 2010) and network entrepreneur personality (Burt, Jannotta, and Mahoney 1998).

In this vein, a recent study has examined the link between how people view themselves as collaborative or independent actors and their propensity to form bridging ties in organizational settings (Srivastava and Banaji 2011). The authors argue that in organizations with strong collaborative norms, the available toolkit of symbols, stories, rituals, and worldviews that people use to justify and make sense of their actions can become constrained (Swidler 1986). As a result, in deliberative – or "discursive" – cognition, they will tend to frame interactions in terms that are consistent with prescribed norms of collaboration even when an objective observer might think otherwise. By contrast, less conscious self-views – or "practical" cognition – will be less susceptible to distortion (Vaisey 2009). The authors develop a technique (described in greater detail below) to measure the latter: the implicit collaborative self-concept. They then demonstrate in a field setting that this measure is positively associated with ties that bridge formal departmental boundaries.

Extending this line of work to the domain of cross-training programs, I argue that participants with a more collaborative, rather than independent, implicit self-concept will be more likely to form and activate ties that bridge formal organizational boundaries. That is, I expect: **H1: The tendency to report activating a greater proportion of bridging ties will be amplified for individuals with a more collaborative, rather than independent, implicit self-concept.**

Sex Differences in the Effects of Cross-Training on Workplace Networks

A robust literature has examined sex differences in workplace networks. For example, males and females have been shown to build segregated networks in organizations (Brass 1985); vary in their propensity to form same-sex connections for instrumental versus expressive purposes (Ibarra 1992a; Ibarra 1997); differ in their level of access to high status contacts (McDonald in press; McGuire 2000); have networks that vary in occupational and socioeconomic diversity (Campbell 1988); and differ in the proportion of kin who belong to their discussion networks (Renzulli, Aldrich, and Moody 2000).

On one hand, this literature might lead one to expect that, relative to females, males will derive greater network-related benefit from cross-training because they are better able to translate structural

positions into network advantage (Ibarra 1992a; Miller 1986; Olson and Miller 1983). For example, Moore (1988: 576) finds that "even women who have attained positions at the pinnacle of powerful national organizations remain less well-connected in informal elite networks than male colleagues….While formally women are insiders among top elites, informally they remain at best on the periphery and perhaps even as outsiders. Similarly, McGuire (2002: 316) concludes from an analysis of workplace networks in a large organization: "Even when Black and white women had jobs in which they controlled resources and had network members who controlled resources, they received less informal help than white men did." Thus, to the extent that cross-training moves people into favorable positions in the organizational structure, male participants might be expected to derive greater network benefit (e.g., network expansion) than females.

Yet cross-training typically involves a temporary move to a new organizational position and affords only transient access to power and resources. As a result, cross-training is unlikely to provide the conditions that would enable males to derive lasting network-related benefits from the change in structural position. Instead, for three reasons, I argue that females will derive more network-related benefit from cross-training. First, jobs in organizations tend to be sex-segregated, with females occupying structurally disadvantaged initial positions (for a review see Reskin, McBrier, and Kmec [1999]). Thus, cross-training will tend to produce a greater improvement in structural position for female employees and thereby differentially enhance their exposure to valuable network resources (Moore 1990; Moore 1992). For example, McGuire's (2000: 519) study of employees in a large financial services company concludes: "Structural exclusion from high-ranking and resourceful positions, not a lack of networking knowledge or skills, prevented White women and people of color from forming ties to powerful network members." A second, related argument focuses on the increased visibility that female employees gain when cross-training moves them out of structurally disadvantaged positions. Improved visibility in turn reduces the effects of stereotyping and promotes network expansion (Kalev 2009). Finally, Burt's (1998) theory of borrowed social capital suggests that more peripheral actors in organizations often lack legitimacy and therefore stand to derive greater benefit when they "borrow" social capital from a high-status, well-connected sponsor. To the extent that cross-training involves assignment to such a sponsor, female participants will derive greater network-related benefit than their male counterparts. Taken together, these arguments suggest: **H2: Relative to male participants, female participants in cross-training will report activating a larger number of workplace ties.**

EMPIRICAL SETTING AND CROSS-TRAINING PROGRAM DESCRIPTION

I tested these hypotheses in the context of a rapidly growing software development laboratory, which was located in the People's Republic of China but part of a US-based global technology products and services firm. The laboratory employed several thousand people and was organized into departments,

corresponding to the firm's global software brands and to various cross-brand programs. Software developed in this laboratory was distributed and used throughout the world. Although most employees were born and educated in China, they were generally proficient in English and, like all employees at this firm, conducted business meetings in English. Finally, the firm as a whole had an explicit strategy to integrate products and services across business units and geographies. As a result, it adopted and reinforced strong collaborative norms throughout the enterprise. That is, it had the kind of organizational culture in which normative pressures are thought to create a disparity between how people view themselves as collaborative actors in deliberative cognition versus less conscious, or implicit, cognition (Srivastava and Banaji 2011).

Over the years, the firm had shifted an increasing share of its software development activity from the United States to less expensive locations such as India and China. As a result, the software development laboratory in China was experiencing rapid growth. Senior management in China recognized that competent managerial talent represented an important constraint on the lab's ability to grow. In the past, the firm had relied on global transfers and rotations as a means to developing the managerial skills of technical employees. The premise behind these programs was that exposure to different parts of the business and new managerial styles would help technical employees learn general management skills and build a broader professional network. Given rapid growth, the software development lab's need for managerial talent outstripped the capacity of the existing global transfer and rotation programs, which were also costly to implement. The head of the software development lab therefore decided to implement a cross-training program, which could partially substitute for the global transfers and rotations that the company had previously used – but at a substantially lower cost.

The particular cross-training program implemented by the company was referred to as the "shadowing" program. It was targeted to well-performing employees who were thought to have management potential. Individuals were nominated for the program by their managers. A program manager in human resources made final selection decisions and then matched participants to senior leaders based on expressed learning needs, preferences, and expected future career path (e.g., technical or managerial track). Matches were made across departmental lines – that is, shadows worked in a different department than the senior leaders to whom they were assigned – so that program participants could gain exposure to different customer requirements, work processes, and internal stakeholders. There were sixteen such departments, each corresponding to a direct report of the laboratory head. The exposure to different departments was thought to not only enhance participants' career development but also promote cross-department collaboration and knowledge exchange.

The mechanics of shadowing worked as follows. Those selected into the program were assigned to shadow a more senior leader for a finite period – typically the equivalent of twelve business days

spread out over two to three months. I henceforth refer to program participants as shadows and senior leaders to whom they were assigned as the executive host. The shadow and his or her executive host had an initial kick off meeting to discuss goals and objectives. The executive host would then grant the shadow access to his or her electronic calendar. Shadows could attend any meeting on the calendar, except for sensitive career discussions between the executive host and a direct report – for example, a performance review. In some cases, executive hosts would also assign shadows a discrete project to complete during the assignment. Although the list of shadows was not formally announced, people generally knew who was shadowing whom at any given point in time. For example, executive hosts would typically introduce their shadows at the start of a meeting. Similarly, colleagues in a shadow's home department would know that the person would be less accessible and have less time for departmental projects. Upon conclusion of the program, shadows would return to their original job role.

I evaluated the shadowing program in two phases. The first, qualitative phase involved semi-structured interviews with past program participants. Insights from this qualitative research informed the design of a field experiment that assessed the program's effects on workplace networks.

PHASE 1: QUALITATIVE EVIDENCE

The qualitative evidence consisted of 40 semi-structured interviews, 30 of which were conducted in person and 10 over the phone. I provide the interview schedule in the appendix. Because this shadowing program had only been recently implemented, there were only 31 alumni at the time I started this study. I invited all of these alumni shadows to participate in the interviews; 22 (71% response rate) agreed to do so. In addition, I invited all 11 executive hosts who had taken on a shadow in the past. All agreed to do so. I also interviewed seven program administrators in human resources. Interviews with executive hosts lasted 30 minutes, while those with shadows and program administrators lasted 45 to 60 minutes. Interviews were tape recorded and transcribed. In all cases, interviewees were told that their individual responses would remain confidential and that no identifying information would be revealed in study reports. Because most interviewees were not native English speakers, I edited some of the quotations reported below for grammar and syntax.

I coded and analyzed the qualitative data using a software tool – Atlas.ti. I focused on the factors that seemed to affect the size, quality, or composition of participants' workplace networks. I started by developing detailed codes, such as "Knowledge about the Skills of Colleagues in Related Units." I later grouped these specific codes into code families or categories, such as "Cross-Boundary Knowledge Acquisition." Finally, I examined and distilled the interrelationships among these categories (depicted below). The interviews did not surface any systematic sex differences in the experiences of participants. Similarly, it was not possible to detect in interviews potential differences among participants in the

implicit collaborative self-concept. The findings reported below instead highlight the mechanisms that seemed to produce network change across the spectrum of past program participants.

The movement of participants to different organizational subunits – though temporary – enabled the transfer of knowledge across internal boundaries. For example, participants gained greater knowledge of adjacent subunits. As one past shadow in the managerial track reported, "When we work on software development, we need to use automation tools to improve efficiency and quality. Before my shadowing experience, I used homemade tools for this automation. It took a long time to develop and maintain these tools. After the [shadowing] program, I learned [the host executive's] team has better tools. So now I just use tools developed by [his] team.…Now I'm starting to share what I'm doing in my team with [his] team." Similarly, the program exposed participants to the skills of colleagues in related units. As a host executive commented, "[The shadows assigned to me] learned about the people in my team, especially the technical leaders. So that would make it easier to collaborate with them in the future." As a result of these knowledge flows, participants and colleagues in the units to which they were assigned often surfaced new opportunities for cross-unit collaboration.

In addition to knowledge flows, the program also expanded the opportunity structure for cross-unit contact. Department meetings provided an important vehicle for these interactions. As a shadow in the technical track reported, "I had heard the name of [the direct reports of my host executive] before but had not had face-to-face meetings with them. In department meetings, I got to sit in front of these people. We got to discuss and debate different topics. We got to know each other's thinking styles. We had lunch together. That made us more familiar with each other." Project teams to which participants were assigned also served to focus and structure interactions (Feld 1981). A shadow in the managerial track stated, "[In the shadowing assignment] I led some projects for [the host executive]. For example, I helped [my host executive] organize his strategy meetings….I had to think about how to organize it. I went to [the host executive], his direct reports, and other senior people to get their experience. I think it's essential for the shadow to take on something concrete. It could be big or small. That practice can really help."

By enabling the flow of knowledge across internal boundaries and creating opportunities for cross-unit contact, the shadowing program served to expand participants' latent network. As one shadow in the managerial track reported, "I build up indirect ties from the experience. The person I was shadowing would introduce me. I would speak up in meetings….I got to know more people, and they got to know me better. Next time, they are able to ask me for help. And if I know that someone knows something, I will feel comfortable asking for help."

Beyond helping participants expand their latent workplace network, the program also created conditions conducive to the conversion of latent ties to active ones. First, it made participants more attractive as network partners. Although interviews varied in their beliefs about the program's effects on

the social standing of participants, a majority thought that selection into the program boosted an individual's status. As a shadow in the technical track reported, "[Being selected into the program] says that your manager cares about your career. He wants to increase your exposure. It's treated as a good sign. You're considered a high potential person. You're considered a technical resource for the future. It makes you a more desirable person for others to know." Moreover, the assignment to a senior manager often served as a visible endorsement of the shadow. A shadow in the managerial track commented, "Usually [my host executive] just introduced me at the beginning of a meeting. She would say, 'He's my shadow.' When her staff found out I was her shadow, they treated me better and gave me more respect….It continued even after the program stopped. They didn't know why I was [my host executive's] shadow. Maybe [she] chose me or maybe I know her very well. So they decided to treat me well."

Finally, the exposure to more senior managers allowed participants to develop self-confidence and reduce the social distance across hierarchical levels. This feature of the program proved especially useful in the Chinese cultural context. As a host executive remarked, "There's a subtle thing about networking. In [the Chinese] culture, the hierarchy of the organization is significant. By increasing their comfort level with senior people, the shadowing program brings the upper levels within reach. This may be less of an issue in the US because the boss isn't on a pedestal in the same way as here." In addition, the program helped participants reduce social distance by understanding and acquiring the norms governing interactions in the senior ranks. For example, a host executive commented, "[Shadows] learn how we interact at the senior levels. One common example is that junior people, when they go to a meeting, tend to communicate in a way that makes others think they can't think out of the box. They'll quickly say, 'Oh, I don't think it can be done.' That's not how executives communicate. My style is to say, 'Let's think about how to break the logjam.' Understanding these nuances of communication is especially useful for young people here in the lab." The reduction of social distance, combined with the status boost provided by the program, allowed certain participants to more readily convert latent ties to active ties. A host executive reported, "With all of my prior shadows, especially those who have good potential, I keep a continuous connection with them. I share some weekend time with them. I keep them in the distribution list." Figure 1 summarizes how the program helped certain participants expand their latent network and later activate these ties. Table 1 provides additional representative quotes for each element of the framework in Figure 1.

- **Figure 1 about here -**
- **Table 1 about here -**

PHASE 2: FIELD EXPERIMENT

After completing the qualitative interviews, I worked with the company to design a field experiment involving the next two batches of program participants. There were 102 new participants who were

assigned to 51 senior leaders (including the 11 who previously participated) in two cycles of implementation. Each cycle lasted about three months. To the best of my knowledge, selection into cycles was based on factors that were exogenous with respect to individual ability or perceived managerial potential – for example, departments facing an impending deadline might prefer to send people nominated from the department to the later program cycle while departments that had just completed an important project milestone or recently hired new staff might prefer to send their nominated people to the first cycle. In other cases, individual-level factors that seemed unrelated to ability or perceived potential – for example, previously scheduled business trips or training programs – determined the choice of cycle.

To support identification of the program's effects, I worked with human resources to construct a control group of non-participants. The firm's corporate human resource policies prohibited the sharing of employee records with external researchers. It was therefore not possible to employ common matching techniques to construct the control group (Rubin 2006). Instead, I asked the program administrator to implement the following procedure. For each program participant, she identified two people who: (1) were at the same salary band; (2) had the same performance rating (on a 1-5 scale) in the prior year; (3) had the same tenure within the organization; (4) worked in the same office; and (5) had not previously participated in the shadowing program. When, as in most cases, more than two people met these criteria, she randomly selected two from the eligible list. In some cases, there was only one person who matched these criteria. In total, 189 people were identified through this procedure.

All 102 program participants and all 189 eligible control group members were invited to participate in the study. They first received an email about the study from the head of the software development lab and then received a follow up note from me with detailed instructions. Program participants were told that the purpose of the study was to help assess the shadowing program as a whole and to identify ways to improve its design. Those in the control group were told that the study's purpose was to understand the dynamics of workplace social networks in the organization. The communication to this group did not mention the shadowing program. 91 treatment group members (89% participation rate), and 85 control group members (45% participation rate) agreed to participate in this research study.

I implemented three waves of on-line surveys to both groups: one month before the shadowing assignment; part of the way through the 2-3 month assignment; and about two months after the assignment ended.[2] Each survey included four network name generators, which were adapted from previous studies of workplace social networks (Podolny and Baron 1997): (1) task advice ("Over the past two months, from whom at [Company] have you received help or advice about your day-to-day work?"); (2) mentorship ("Over the past two months, from whom at [Company] have you received help or advice

[2]Because the program was administered in two separate cycles, there were actually six survey waves. Control group members received their surveys at the same time as their corresponding treatment group.

about your career or professional development?"); (3) strategic intelligence ("Over the past two months, from whom at [Company] have you received strategic information about the company; e.g., the goals and choices of important individuals, divisions, and [the Company] as a whole?"); and (4) friendship ("Over the past two months, with whom at [Company] have you socialized outside of a work context?"). The surveys for program participants also included questions about their experience with the shadowing assignment – for example, how many hours per week they spent shadowing the senior leader and how well they felt the program met its objectives. In addition, both sets of surveys included questions about respondents' work history and sociodemographic characteristics. Immediately after completing the Wave 1 survey, subjects were asked to complete a timed categorization exercise (described in greater detail below) to measure their implicit collaborative self-concept.

Among the questions about respondents' work history was one asking if they had previously participated in a shadowing or other comparable rotational program. For example, the company had a long history of assigning a small number of high potential individuals to serve on a temporary assignment as an Executive Assistant (similar to an aide-de-camp to a military officer, rather than an administrative assistant) to a high-ranking executive. In addition, there were various informal, smaller-scale shadowing and rotational programs in various offices. A total of 37 individuals – 21 in the control group and 16 in the treatment group – reported having had at least one such an experience in the past. Because the baseline networks of these individuals presumably reflected any potential effects of participation in these past programs, I excluded these individuals from the analyses reported below.[3]

Table 2 reports the characteristics of the resulting sample of 139 individuals (64 in the control group and 75 in the treatment group) who had no prior experience with shadowing or rotational programs. There were no statistically significant differences between these groups on observable characteristics or prior career history as reported in the Wave 1 survey.

- Table 2 about here -

Finally, it is important to note that, even though participants were encouraged to complete all three waves of the study, some participants only completed one or two surveys. Such sample attrition is a well-recognized problem in longitudinal network studies (Huisman and Steglich 2008; Kossinets 2006). In this case, 139 respondents completed all three surveys, while 99 respondents completed only one or two surveys. That is, the overall attrition rate was 29%. There was slightly more attrition in the treatment group (32%) than in the control group (25%). Table 3 reports the characteristics of those who completed all three survey waves to those who did not complete all three waves. There were no statistically significant differences between the two groups. Similarly, not all subjects completed the timed categorization exercise required to calculate their implicit collaborative self-concept. These data were

[3]Including the 37 individuals in the analyses reported below did not materially change the results reported below.

missing for 24 out of 176 (24%) of subjects. There were again no statistically significant differences on observable characteristics (same as in Table 3) between those who completed the exercise and those who did not. Nevertheless, I further accounted for sample attrition and missing implicit collaborative self-concept data using inverse probability weighting (Horvitz and Thompson 1952; Robins, Rotnitzky, and Zhao 1995). I report these results in the Robustness Checks section below.

- Table 3 about here -

Measures and Estimation

I identified the treatment effect of participation in the program using differences-in-differences estimation with individual fixed effects to account for all unobserved, time-invariant individual differences – for example, stable personality traits such as extraversion. For Baseline Hypothesis A, response variables included measures of the number of ties reported in each survey wave, including: (a) all ties; (b) task advice ties; (c) strategic intelligence ties; (d) mentorship ties; and (e) friendship ties. The indicator variable, *Treatment*, was set to 1 for program participants. I also created indicators for survey wave: *During Program*, which was set to 1 for Wave 2 responses, and *After Program*, which was set to 1 for Wave 3 responses. The interaction term, *During Program x Treatment*, therefore represents the treatment effect during the program, and the term, *After Program x Treatment*, thus represents the treatment effect that persisted for at least two months after the program concluded. For purposes of hypothesis testing, I focus on the latter (*After Program x Treatment*) because by Wave 3 all subjects had been fully treated. I estimated conditional fixed effect Poisson quasi-maximum likelihood regression models (Wooldridge 1997; Wooldridge 1999) because the response variables were counts of the number of ties activated. The Poisson quasi-maximum likelihood estimator is consistent under relatively weak assumptions: only the conditional mean need be correctly specified, and the standard errors are adjusted to account for over (under) dispersion.

For Baseline Hypothesis B and Hypothesis 1, the response variable was the proportion of bridging ties that subjects reported activating in each survey wave. I classified a tie as bridging if the contact listed was not in the same department as the respondent and estimated conditional fixed effect fractional logit models because the response variable could vary between 0 and 1 (Papke and Wooldridge 1996). For hypothesis tests, I again considered the interaction terms corresponding to Wave 3 – *After Program x Treatment* (Baseline Hypothesis B) and *After Program x Treatment x Implicit Collaborative Self-Concept* (Hypothesis 1).

For Hypothesis 1, to measure the implicit collaborative self-concept, I adapted a previously developed procedure (Srivastava and Banaji 2011). The procedure is based on the Implicit Association Test (IAT) (Greenwald, McGhee, and Schwartz 1998) – the most widely used instrument for measuring aspects of implicit cognition (for a review of different approaches to measuring implicit cognition, see

Wittenbrink and Schwarz [2007]). The IAT requires subjects to rapidly sort words representing different categories into groupings. It assumes that subjects will find it easier, and will therefore take less time, to sort some feature that is readily discerned in the subject's mind, compared with items that are not readily distinguished (for examples of the procedure and a meta analysis of the IAT's predictive validity, see Greenwald, Poehlman, Uhlmann, and Banaji [2009]). Given that the study population comprised working professionals who were time constrained, I used a recently developed, brief version of the IAT (Sriram and Greenwald 2009), which I implemented using a widely available software program (Inquisit 2006).

For this particular IAT, the categories and associated stimulus words were: (1) "Self" ("I," "self," "me," "myself"); (2) "Other' ("other," "they," "them," "their"); (3) "Collaborative" ("coordination," "together," "collaborative," and "partnership"); and (4) "Independent" ("autonomous," "solo," "independent," and "individual"). On their computer screens, subjects were presented with two configurations of these categories, "Collaborative-Self" and "Independent-Self," with the order randomly determined. In each configuration, twenty randomly selected stimulus words flashed in succession on the screen. Subjects were asked to indicate with the press of the "K" key if the stimulus word corresponded to either of the two categories shown at the top of the screen. They were instructed to press the "D" key if the stimulus word did not correspond to either category. For example, if the configuration displayed were "Collaborative-Self," then subjects would press the "K" key if stimulus word displayed was "coordination" or "myself." They would press the "D" key if the stimulus word displayed was "autonomous" or "other." They were instructed to make this determination as rapidly as possible, while minimizing the number of errors. The software program kept track (in milliseconds) of how long it took subjects to categorize the stimulus words and of any errors they made.

Consistent with prior IAT research (Lane, Banaji, Nosek, and Greenwald 2007), I took several steps to address potential quality problems in responses. First, I gave subjects a practice exercise to complete before completing the implicit collaborative self-concept exercise. The purpose of the practice exercise was to familiarize subjects with the IAT procedure and reduce variability from different rates of learning. For the practice exercise, the categories and associated stimuli were: (1) "Male" ("man," "male," "he," "brother"); (2) "Female" ("woman," "female," "she," "sister"); (3) "Self" (same stimuli as above); and (4) "Other" (same stimuli as above). They were presented with two configurations of these categories, "Male-Self" and "Female-Self". Eight randomly selected stimulus flashed in succession on the screen for each of the two configurations ("Male-Self" and "Female-Self"). Second, to address the possibility that subjects stepped away from their computers in the middle of the exercise or otherwise became distracted, I eliminated all trials with latencies over 10,000 milliseconds. To account for the possibility that subjects were rushing through the study and not processing the stimuli, I eliminated subjects if more than ten percent of their trials had latencies less than 300 milliseconds. Finally, I added a

200 millisecond penalty if subjects made an error in classifying stimuli. After making these adjustments, I calculated the implicit collaborative self-concept (ICS) as follows:

$$ICS = [\text{Mean Latency (Independent-Self)} - \text{Mean Latency (Collaborative-Self)}] / \sigma_{pooled}$$

Where: σ_{pooled} = pooled standard deviation (across all 40 trials)

Higher (lower) values of this measure therefore suggest that a subject views herself as more (less) collaborative, rather than independent, in implicit cognition.

For Hypothesis 2, I reverted to conditional fixed effect Poisson quasi-maximum likelihood regression models, this time including an indicator variable, *Female*, and its relevant two-way (*During Program x Female* and *After Program x Female)* and three-way *(During Program x Treatment x Female* and *After Program x Treatment x Female)* interaction terms. I focus on *After Program x Treatment x Female* for hypothesis tests.

Results

I start by reporting descriptive statistics on reported ties activated by the treatment and control groups. In the control group, there was a decline in reported ties activated, from 10.5 in Wave 1 to 7.7 in Wave 3. One possible explanation for this decline is respondent fatigue in completing the same instrument three different times (for a discussion of data quality issues in online social network surveys, see Matzat and Snijders [2010]). By comparison, and consistent with Baseline Hypothesis A, the treatment group reported an increase in the number of ties activated, from 8.3 in Wave 1 to 10.3 in Wave 3. Assuming the control group reflected the baseline trend toward survey fatigue in repeated administrations of this instrument, the 24% increase in reported ties activated by the treatment group likely represents a conservative measure of the treatment effect. The descriptive statistics lend no support for Baseline Hypothesis B. For the control group, 38% of ties reported in Wave 1 were bridging ties, while this proportion dropped to 32% in Wave 3. Similarly, for the treatment group, the proportion of bridging ties dropped from 40% in Wave 1 to 31% in Wave 3. Survey fatigue may similarly account for these reductions. Given that participants reported fewer ties in subsequent survey waves, they may have erred on the side of reporting stronger ties, which are more likely to be those within the same department (Friedkin 1982). Consistent with Hypothesis 1, program participants with an implicit collaborative self-concept above the mean reported a comparatively small decline in the proportion of bridging ties reported (decline of 3 percentage points) than those below in the mean in implicit collaborative self-concept (decline of 15 percentage points).[4] Finally, consistent with Hypothesis 2, the treatment effect appeared to

[4]It is not possible in the context of these data to tell whether those with a more collaborative implicit self-concept actually formed more bridging ties during cross-training or were simply more likely to recall and report bridging ties among the ties they reported activating. Future research can profitably examine this distinction by collecting not only network ties that are self-reported but also those derived from more objective sources (e.g., email exchange).

be stronger for female participants. Females in the control group activated 8.2 ties in Wave 1 and 6.7 ties in Wave 3, while females in the treatment group activated 7.1 ties in Wave 1 and 13.5 ties in Wave 3.

Table 4 reports results of regression analyses used to formally test Baseline Hypothesis A – that participation in the program will lead to an expansion in the number of ties activated by program participants. Model 1 provides differences-in-differences estimates from a conditional fixed effects Poisson Quasi-Maximum Likelihood regression. The positive and significant coefficients for *During Program x Treatment* ($p<.01$) and *After Program x Treatment* ($p<.05$) suggest a positive treatment effect on total ties activated – an effect that persisted even two months after the program concluded. Models 2 through 5 provide differences-in-differences estimates for the four kinds of ties reported. Model 2 indicates a positive and persistent treatment effect for task advice ties. Model 3 suggests that the positive treatment effect for strategic intelligence ties did not persist once the program concluded. In Model 4, which considered mentorship ties, *After Program x Treatment* is positive and significant; however, the model as a whole is only marginally significant ($p<.10$). Finally, Model 5 indicates that the program had no significant effect on friendship ties. Together, Models 1 through 5 lend support for Baseline Hypothesis A. Moreover, they suggest that the program was most effective in producing a positive and lasting increase in task advice ties.

- **Table 4 about here -**

Table 5 includes results that speak to Baseline Hypothesis B – about the program's effects on the proportion of bridging ties activated by participants. In Model 6, neither *During Program x Treatment* nor *After Program x Treatment* is significant. In Models 7 through 10, *During Program x Treatment* is not significant, and in all but Model 8, *After Program x Treatment* is also not significant. In Model 8, contrary to expectations, *After Program x Treatment* has a negative and significant ($p<.001$) coefficient. That is, participation in the program appeared to lead to a decrease in the proportion of bridging strategic ties, perhaps because participants became more reliant on just their executive host, rather than their broader network, for strategic intelligence. Overall, these results do not support Baseline Hypothesis B.

- **Table 5 about here -**

Table 6 reports results related to Hypothesis 1 – that the tendency to form and activate bridging ties following program participation will be amplified for individuals with a more collaborative, rather than independent, implicit self-concept. In Model 11, *During Program x Treatment x Implicit Collaborative Self-Concept* is positive but not significant, while *After Program x Treatment x Implicit Collaborative Self-Concept* is positive and significant ($p<.05$). In Model 12, *After Program x Treatment x Implicit Collaborative Self-Concept* is also positive and significant ($p<.01$). That is, the implicit collaborative self-concept positively moderated the program's effects on the proportion of bridging ties, particularly task-related bridging ties, that participants reported activating two months after the program

concluded. Hypothesis 1 is therefore supported.[5] Surprisingly, the coefficient for *After Program x Implicit Collaborative Self-Concept* in Model 12 was negative and significant, suggesting that more implicitly collaborative members of the control group reporting activating a lower proportion of bridging ties following program participation.

- **Table 6 about here** -

Table 7 reports results that correspond to Hypothesis 2 – that participation in the program will have a more positive effect on the formation and activation of ties for female participants, relative to males. Model 16 provides the differences-in-differences estimates from a conditional fixed effects Poisson regression that includes the three-way interaction terms, *During Program x Treatment x Female* and *After Program x Treatment x Female*. The former is not significant, while the latter is positive and significant ($p<.001$). That is, the treatment effect was not significant for males but strongly positive and significant for females. Thus, Hypothesis 2 is supported. Models 17 through 20 indicate that sex-based differences in the treatment effect were associated with task advice and mentorship ties – but not with strategic intelligence or friendship ties.[6]

- **Table 7 about here** -

Robustness Checks

The lack of random assignment means that one cannot fully rule out the possibility that the treatment and control groups varied on salient, *time-varying*, unobserved characteristics or the results partially reflect unobserved factors that influenced selection into treatment. (The inclusion of individual effects accounted for time-invariant unobserved differences.) I therefore conducted a supplemental analysis in which I took advantage of the fact that the program was administered in two cycles and that assignment to cycles seemed to occur for more or less random reasons (e.g., which department had recently completed a major project milestone or which individual had a previously scheduled business trip that coincided with one of the cycle dates). I compared the Wave 3 survey results for the treatment group from one cycle to the Wave 1 survey results for the treatment group from the other cycle. To put it differently, I used one cycle of the treatment group as a control against which to compare the treatment outcomes of the other cycle. Because both cycles were selected for (and ultimately received) treatment, they are likely to be

[5]In a supplemental analysis, I also considered the potential moderating role of the explicit – that is, self-reported – measure of the collaborative self-concept. I used a 7-point self-reported measure (Srivastava and Banaji 2011). Consistent with Srivastava and Banaji's findings, the self-reported measure was not associated with bridging ties (i.e., *During Program x Treatment x Explicit Collaborative Self-Concept* and *After Program x Treatment x Explicit Collaborative Self-Concept* were not significant covariates), while the implicit measure was positively associated with bridging ties. To address potential measurement error stemming from a single-item explicit measure, I also constructed a four-item alternative measure (sample item: "How often do you agree to help or support others on their work assignments?"). This four-item measure was also not associated with the tendency to form bridging ties.

[6]In supplemental analyses (not reported), I also tested for an interaction between sex and the proportion of bridging ties reported. In these regressions, *After Program x Treatment x Female* was not a significant covariate.

comparable on both observed and unobserved factors. As a check on this assumption, I confirmed that there were no statistically significant differences between these groups on observable traits (i.e., the variables reported in Table 2). Because there was some further potential for participants in the first cycle to talk about their experiences in the program with participants in the second cycle (and thereby influence the Wave 1 reports of Cycle 2 participants), I focused on the following comparison: the Wave 3 data of Cycle 2 participants versus the Wave 1 data of Cycle 1 participants. This analysis revealed support for Baseline Hypothesis A. Cycle 2 participants reported 11.8 ties in Wave 3, while Cycle 1 participants reported 8.07 ties in Wave 1 (t statistic=2.27; p=.026). There was no support for Baseline Hypothesis B. Cycle 2 participants reported that 26% of ties activated in Wave 3 were bridging ties, while Cycle 1 participants reported that 40% of ties activated in Wave 1 were bridging (t statistic=-1.62; p=.101). Consistent with Hypothesis 1, the decline in reported bridging ties was attenuated participants with an implicit collaborative self-concept above the mean (36% for Cycle 2, Wave 3 vs. 40% for Cycle 1, Wave 1; not significant) and more pronounced for participants with an implicit collaborative self-concept below the mean (11% for cycle 2, Wave 3 vs. 40% for cycle 1, Wave 1; p=.028). Finally, consistent with Hypothesis 2, the treatment effect appeared to be stronger for female, rather than male, participants. Female participants in cycle 2 reported 17.0 ties in Wave 3, while female participants in cycle 1 reported 6.4 ties in Wave 1 (t statistic=3.21; p=.007). Male participants in cycle 2 reported 10.2 ties in Wave 3, while males participants in cycle 1 reported 8.5 ties (t statistic=0.930; p=.357). In sum, this supplemental analysis largely corroborates the results of the differences-in-differences analysis and helps to address concerns about the lack of random assignment in the study design.

Although there were no significant differences in observable characteristics between those who completed all three survey waves and those who did not or between those who completed the IAT procedure and those who did not, it is still possible sample attrition and missing data served to bias the estimates. To better account for these factors, I estimated the differences-in-differences models using inverse probability weighting (IPW) (Horvitz and Thompson 1952; Robins, Rotnitzky, and Zhao 1995; Wooldridge 2002). Specifically, I first estimated a logit model in which an indicator variable set to 1 for subjects who participated in all three survey waves was regressed on age, tenure within the firm, and whether or not the person held an advanced degree. I then calculated the inverse of the predicted probabilities. Next I re-estimated the models, while weighting the observations by these inverse predicted probabilities. The results were comparable to those reported in Tables 4, 5, 6, and 7, with two exceptions: (1) *After Program x Treatment x Implicit Collaborative Self-Concept* in Model 11 was marginally significant (p=.08) with IPW but significant (p<.05) otherwise; and (2) *After Program x Treatment x Female* in Model 20 was significant (p<.05) with IPW but marginally significant (p=.054) otherwise. I repeated this procedure with a logit model in which the response variable was an indicator set to 1 for

subjects who completed the IAT procedure to measure their implicit collaborative self-concept. Again, weighting the observations by the inverse of the predicted probability of participants completing the IAT procedure yielded comparable results to those reported above.

DISCUSSION AND CONCLUSION

The goal of this article has been to identify the effects of a common workplace practice – cross-training – on the interpersonal networks of employees. I report findings from 40 semi-structured interviews and the results of a longitudinal field experiment involving 176 employees in a software development laboratory in China. In developing the theoretical arguments, I draw the distinction between new tie formation and the activation of pre-existing ties (Hurlbert, Haines, and Beggs 2000). I argue that, relative to non-participants, participants in cross-training will report an increase in activated ties and report a greater proportion of bridging ties because cross-training will expand their opportunity structure for contact and decrease the cognitive barriers to network activation across internal organizational boundaries (Blau 1977; Feld 1981; Marks, Sabella, Burke, and Zaccaro 2002). Results from the field experiment indicate that participants in cross-training did report an increase in activated ties – in particular, those involving task advice and mentorship – but not a general increase in the proportion of bridging ties. I further argue that a cognitive orientation – the implicit collaborative self-concept (Srivastava and Banaji 2011) – will positively moderate the effects of cross-training on the proportion of bridging ties reported by participants. Findings from the field experiment support this view. Finally, I argue that females will experience greater network benefit from cross-training than males because participating in such programs ameliorates the structural disadvantages of job segregation (McGuire 2000; Moore 1990), increases the visibility of females and helps overcome the negative effects of stereotyping (Kalev 2009), and – to the extent that it involves assignment to a high-status sponsor – enables females to gain greater legitimacy by borrowing social capital from a well-connected individual (Burt 1998). The results are consistent with this expectation: females participating in cross-training reported activating more ties – including those related to task advice and mentorship – than did their male counterparts. The qualitative evidence provides greater insight into the mechanisms – for example, exposure to the skills of colleagues in other subunits and increased self-confidence of program participants – that underpinned these effects.

Findings from this study contribute to three distinct literatures. First, the study brings to research on work practices and employee outcomes (Cappelli, Bassi, Katz, Knoke, Osterman, and Useem 1997; Cappelli and Neumark 2001; Kalleberg, Marsden, Reynolds, and Knoke 2006; Osterman 2000) empirical evidence about the link between cross-training, a practice that has diffused broadly across organizations, and workplace networks. Whereas prior research had theorized such a connection, this study represents – to the best of my knowledge – the first to empirically assess how cross-training shapes networks. It also

provides insight into sub-populations that are most likely to benefit when a firm introduces such practices and the mechanisms through which these practices produce network change.

The findings also contribute to a growing body of research that seeks to identify the link between aspects of individual cognition and network formation and change (Kilduff and Krackhardt 1994; Lizardo 2006; Srivastava 2012a; Vaisey and Lizardo 2010). The study shows how individual differences in cognition – in particular, the implicit collaborative self-concept (Srivastava and Banaji 2011) – can influence who stands to benefit most from employee development programs designed to expand or extend workplace networks. Whereas prior research established the association between the implicit collaborative self-concept and bridging ties in a laboratory study and in cross-sectional network analysis, this study demonstrates the link between this cognitive orientation and subsequent network change. Moreover, the inclusion of individual fixed effects in the analysis provides greater assurance that these results were not influenced by other, potentially related stable individual differences such as extraversion (Doeven-Eggens, De Fruyt, Hendriks, Bosker, and Van der Werf 2008) or self-monitoring (Mehra, Kilduff, and Brass 2001; Sasovova, Mehra, Borgatti, and Schippers 2010).

Finally, the results from this study contribute to research on organizational practices and gender inequality in the workplace (DiPrete and Nonnemaker 1997; Huffman, Cohen, and Pearlman 2010; Kalev 2009; Kalev, Kelly, and Dobbin 2006). Although previous studies argued that workplace practices designed to support greater cross-functional collaboration will lead to declines in ascriptive inequality, the core mechanism of network change was unobserved in prior research (Kalev 2009). This study provides direct evidence of the effects of cross-training on the networks of male and female employees. The results – that female participants in cross-training reported a larger expansion in activated networks than did males – provide strong empirical support for McGuire's (2000: 519) contention that programs such as cross-training are essential if companies seek to "equalize access to informal networks at work."

In sum, this study demonstrates the value of longitudinal field experiments in uncovering the complex interplay among workplace practices, individual differences, and workplace networks. Such an approach promises to help network research in continuing to make the shift from simply characterizing internal network patterns and associated outcomes to producing tangible prescriptions about organizational practices that can serve to reshape workplace networks in ways that support individual attainment and ameliorate inequality.

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Figure 1: Network Change Following Cross-Training Program

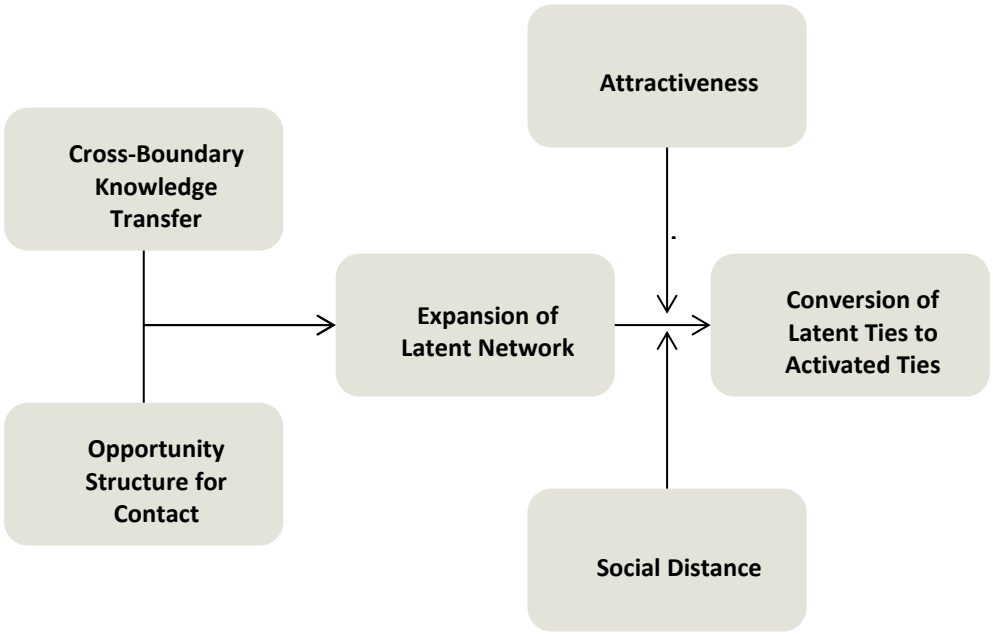

Table 1: Qualitative Evidence – Network Change Following Program Participation

Category	Mechanism	Representative Quotes
Cross-Boundary Knowledge Transfer	Knowledge about Work Activity of Related Units	"Through this program, I hoped to find some connections in our work – some mutual benefit or a common path. For example, for a project [the host executive] is working on, I might be able to help give resources from my own team." – Shadow, Technical Track "By observing the daily activity of a higher-level leader (who is usually no more than 2-3 levels up), [shadows] get a chance to see how a different portion of the business runs. Because they usually come from a related area and are not so far removed from the leader, they can learn from what they see. They wouldn't be able to shadow the CEO or even [the head of the lab] and get the same value from it." – Host Executive
	Knowledge about Skills of Colleagues in Related Units	"At a technical level, I know more people. I have an awareness of what they know. But they are not concrete relationships because I didn't have the opportunity to have personal talk or social talk with them." – Shadow, Technical Track "Now I know mission and resources of people [within the department of the senior leader to whom I was assigned]. That has given me some ideas about resource borrowing and rotation between our departments….I don't need to go [the senior leader] to make this happen. I can go directly to his team." – Shadow, Managerial Track
Opportunity Structure for Interaction	Meetings	"[My host executive] invited me to all of his manager meetings. He had KPI [key performance indicator] review meetings and special topic meetings. I attended about one meeting per week, 2 to 3 hours per meeting. In the first meeting, Jack introduced me to everyone. He introduced his managers to me. He told everyone the objective the shadowing assignment. He gave me an opportunity to introduce myself and my business to everyone." – Shadow, Managerial Track "[My host executive] invited me to participate in strategy meetings for [the software development lab]. I got to meet all of [the head of the lab's] direct reports. And I met some external people from our partner companies and sales people outside of [the lab]." – Shadow, Managerial Track
	Project Assignments	"Before the shadowing program, I just worked with people…who were directly involved in my projects. Otherwise, the only other people I knew were ones I got to know through [company's] online communities. During the shadowing program, though, [the senior leader to whom I was assigned] had me participate in many projects. So I got to know many more people that way." – Shadow, Technical Track "My main project was drafting a sales and development strategy for the next year. That was a very good opportunity for me to learn about the priorities for different brands and how we implement development activities to achieve group goals. I reviewed the slides with each the executive of each brand. That process gave me a very good visibility with these people." – Shadow, Managerial Track

Table 1: Qualitative Evidence – Network Change Following Program Participation (continued)

Outcome		Representative Quotes
Expansion of Latent Network		"If I were to estimate the size of the increase in their network from the shadowing experience, I'd say it's maybe a 10-20% increase. That's because matches are usually made for job-related reasons: they pick me to shadow because they think it will be helpful for their job." – Host Executive "I was exposed to something like 40-50 new people through the program. Maybe 10 of them became part of my network. Normally they were in a different business unit. If they were in the same business unit, I would have known them already. Normally, these were people more senior than me." – Shadow, Technical Track
Category	**Mechanism**	**Representative Quotes**
Attractiveness	Status	"You are viewed as being as a top prospect, like in baseball. Someone in the minor leagues who could get called up to the major leagues. Some people would view shadows from that perspective. They must be among the elite." – Shadow, Managerial Track "I felt I got some extra respect [during the assignment]. It meant that the company recognized me and wants to develop me. But things went back to normal [after the program ended]." – Shadow, Managerial Track
	Visible Endorsement	"The first role of [my host executive] was in introducing me to his guys. He provided the channel. He also encouraged his employees to share information with me without any hesitation." – Shadow, Technical Track "I think [my host executive's] introduction helped send a signal about me. When I followed up with people, I got responses very fast because it was known that I was working with [the senior leader]. Even when he introduced me by email, they'd respond quickly. But I'm not sure that influence is very long-lasting….I don't have reason to be in touch with many of those people anymore. But I guess when I contacted [two colleagues in senior leader's department], they did respond quickly. In that case, though, we had some direct experience working together during shadow program." – Shadow, Technical Track

Table 1: Qualitative Evidence – Network Change Following Program Participation (continued)

Category	Mechanism	Representative Quotes
Social Distance	Self-Confidence	"There can be a huge distance emotionally between manager and worker. In this culture, a third-line manager is like a deity. The shadowing program helps shrink the gap." – Host Executive "I became more confident. It proved to me that I can be helpful to others. Now I feel I can reach out to people even if I don't know them. I'm also telling [my direct reports]: 'Don't hesitate to talk to people, even if you don't know them'." – Shadow, Managerial Track
Social Distance	Norm Acquisition	"The most helpful thing about the program is being able to observe the interactions of senior people. You can see how [executives] fight and compete against each other. You can see how they show off in front of their own bosses – of how they perform to make themselves look good. That's a real eye-opener. Also, you learn how they handle different kinds of meetings. For example, the way they manage strategy meetings." – Shadow, Managerial Track "The shadowing program helps junior people understand how senior people think." – Host Executive
Outcome		**Representative Quotes**
Conversion of Latent Ties to Activated Ties		"I go to [contacts I met through the shadowing program] for help with knowledge sharing between our teams and technical discussions." – Shadow, Managerial Track "I still call [a prior shadow] to help me with strategy updates. I ask him, 'Do you have time to help?' For lots of tasks we simply don't have headcount allocated in my department. So I talk to my old shadow, who understands what is needed. Or I even send my people – 'Please go to talk to [prior shadow].' I still feel there is a connection there." – Host Executive "I still go to [the senior leader to whom I was assigned] for information about the organization and politics. He is more open and has a perspective on such things." – Shadow, Technical Track

Table 2: Sample Characteristics – Comparison of Control and Treatment Groups

Variable	Control Group	Treatment Group	t-statistic / p value
Age (Years)	36.1	35.7	0.512 / 0.610
Tenure within Firm (Years)	6.09	5.68	0.653 / 0.515
Tenure outside Firm (Years)	4.16	4.91	-0.921 / 0.359
Proportion Holding Advanced Degree	0.781	0.747	0.475/ 0.636
Proportion Female	0.172	0.267	-1.337 / 0.183
Past Career Mobility within Organization (Sum of Prior Changes in Job Role, Supervisor, Business Unit, Office, and Project Team)	9.88	10.7	-0.390 / 0.697
Number of Prior Promotions within Firm	1.44	1.33	0.717 / 0.475

N = 64 for control group and 75 for treatment group.

Table 3: Comparison of Individuals – Completed vs. Did Not Complete All Waves

Variable	Completed All Three Waves	Did Not Complete All Three Waves	t-statistic / p value
Age (Years)	35.4	36.4	-1.197 / 0.234
Tenure within Firm (Years)	5.89	5.85	0.070 / 0.944
Tenure outside Firm (Years)	4.19	4.89	-0.868 / 0.387
Proportion Holding Advanced Degree	0.727	0.795	-.927 / 0.356
Proportion Female	0.197	0.247	-0.698 / 0.487
Past Career Mobility within Organization (Sum of Prior Changes in Job Role, Supervisor, Business Unit, Office, and Project Team)	11.0	9.66	0.637 / 0.525
Number of Prior Promotions within Firm	1.38	1.39	-0.082 / 0.935

Table 4: Conditional Fixed Effects Poisson Quasi-Maximum Likelihood Regression of Reported Ties Activated on Covariates – Baseline Hypothesis A

	Model 1: All Ties	Model 2: Task Advice Ties	Model 3: Strategic Intelligence Ties	Model 4: Mentorship Ties	Model 5: Friendship Ties
During Program	-0.229*	-0.273	-0.097	-0.240	-0.249
	(0.112)	(0.144)	(0.107)	(0.124)	(0.205)
During Program	0.431**	0.579**	0.460**	0.288	0.292
x Treatment	(0.152)	(0.213)	(0.157)	(0.172)	(0.302)
After Program	-0.267*	-0.463**	-0.163	-0.339*	0.022
	(0.112)	(0.162)	(0.133)	(0.132)	(0.185)
After Program x	0.306*	0.596**	0.200	0.353*	-0.080
Treatment	(0.151)	(0.226)	(0.161)	(0.171)	(0.267)
Chi2	11.703	12.565	13.389	8.456	3.953
prob>Chi2	0.020	0.014	0.010	0.076	0.412
N	361	361	361	361	361

* p<0.05, ** p<0.01, *** p<0.001; fixed effect coefficients not reported.

Table 5: Conditional Fixed Effects Fractional Logit Regression of Proportion Bridging Ties on Covariates – Baseline Hypothesis B

	Model 6: All Ties	Model 7: Task Advice Ties	Model 8: Strategic Intelligence Ties	Model 9: Mentorship Ties	Model 10: Friendship Ties
During Program	-0.093	-0.317	-0.063	-0.372	0.139
	(0.192)	(0.349)	(0.447)	(0.341)	(0.299)
During Program	-0.188	0.132	-0.569	0.280	0.440
x Treatment	(0.308)	(0.510)	(0.612)	(0.543)	(0.352)
After Program	-0.107	-0.755*	0.664	-0.904	-0.189
	(0.214)	(0.368)	(0.368)	(0.483)	(0.342)
After Program x	-0.603	-0.183	-1.997***	0.205	0.317
Treatment	(0.317)	(0.530)	(0.552)	(0.662)	(0.410)
Constant	0.330	0.604	1.326**	0.396	-0.337
	(0.708)	(0.811)	(0.419)	(1.292)	(0.178)
Chi2	1.3e+08	5.7e+09	2.0e+13	56008	4.76
prob>Chi2	0.000	0.000	0.000	0.000	0.313
N	343	336	305	308	256

* p<0.05, ** p<0.01, *** p<0.001; Fixed effects included but coefficients not reported for Models 6-9; Model 10 could not be estimated with fixed effects so results reported are without fixed effects.

Table 6: Conditional Fixed Effects Fractional Logit Regression of Proportion Bridging Ties on Covariates – Hypothesis 1

	Model 11: All Ties	Model 12: Task Advice Ties	Model 13: Strategic Intelligence Ties	Model 14: Mentorship Ties	Model 15: Friendship Ties
During Program	-0.064	-0.249	0.217	-0.490	0.155
	(0.186)	(0.360)	(0.478)	(0.347)	(0.390)
During Program x Treatment	-0.528	-0.277	-1.142	-0.296	0.281
	(0.283)	(0.505)	(0.634)	(0.532)	(0.447)
During Program x Implicit Collaborative Self-Concept	-0.057	-1.443	-1.951	1.788*	-0.929
	(0.518)	(1.086)	(1.359)	(0.774)	(1.140)
During Program x Treatment x Implicit Collaborative Self-Concept	0.705	2.047	3.183	-0.455	-0.144
	(0.806)	(1.507)	(1.797)	(1.274)	(1.358)
After Program	-0.134	-0.934*	0.579	-1.271*	-0.349
	(0.275)	(0.468)	(0.399)	(0.634)	(0.411)
After Program x Treatment	-0.764*	-0.359	-1.954***	-0.192	0.564
	(0.359)	(0.616)	(0.582)	(0.784)	(0.476)
After Program x Implicit Collaborative Self-Concept	-0.970	-3.391**	-0.026	-1.588	-1.873
	(0.699)	(1.278)	(1.040)	(1.729)	(1.172)
After Program x Treatment x Implicit Collaborative Self-Concept	1.921*	4.697**	1.153	3.302	2.523
	(0.866)	(1.577)	(1.374)	(2.084)	(1.395)
Constant	0.602	0.970	1.855***	1.417	-0.325
	(0.715)	(0.821)	(0.481)	(1.275)	(0.191)
Chi2	1.3e+09	4.7e+09	7.5e+08	36300	8.690
prob>Chi2	0.000	0.000	0.000	0.000	0.369
N	243	240	220	221	187

* p<0.05, ** p<0.01, *** p<0.001; Fixed effects included but coefficients not reported for Models 11-14; Model 15 could not be estimated with fixed effects so results reported are without fixed effects.

Table 7: Conditional Fixed Effects Poisson Regression of Degree on Covariates – Hypothesis 2

	Model 16: All Ties	Model 17: Task Advice Ties	Model 18: Strategic Intelligence Ties	Model 19: Mentorship Ties	Model 20: Friendship Ties
During Program	-0.262*	-0.311*	-0.111	-0.267*	-0.316
	(0.119)	(0.150)	(0.109)	(0.131)	(0.226)
During Program x Treatment	0.354*	0.539*	0.379*	0.187	0.207
	(0.174)	(0.242)	(0.178)	(0.187)	(0.347)
During Program x Female	0.361	0.425	0.224	0.299	0.578
	(0.270)	(0.317)	(0.534)	(0.299)	(0.335)
During Program x Treatment x Female	0.021	-0.129	0.120	0.116	-0.070
	(0.317)	(0.429)	(0.581)	(0.412)	(0.528)
After Program	-0.242*	-0.415*	-0.167	-0.304*	0.012
	(0.120)	(0.164)	(0.138)	(0.148)	(0.198)
After Program x Treatment	0.110	0.424	0.133	0.075	-0.338
	(0.171)	(0.251)	(0.177)	(0.187)	(0.313)
After Program x Female	-0.449*	-0.773	0.043	-0.348*	-0.163
	(0.194)	(0.466)	(0.490)	(0.172)	(0.367)
After Program x Treatment x Female	1.007***	1.216*	0.200	1.091***	0.962
	(0.276)	(0.563)	(0.529)	(0.297)	(0.498)
Chi2	58.154	22.517	20.714	77.977	15.437
prob>Chi2	1.07e-09	.0040424	.0079478	1.25e-13	.0511794
N	361	361	361	361	361

* p<0.05, ** p<0.01, *** p<0.001; fixed effect coefficients not reported.

Appendix A: Interview Schedule

1. Could you please give a brief summary of your career history?
2. Why did you choose to participate in the shadowing program? What were you hoping to get out of the experience?
3. What did it mean to [you / your shadow] to be selected into the program? How was it viewed more generally in the organization?
4. [Who are the people who have shadowed you to date? / Whom have you shadowed?] How was the match made? How much influence did you and the other person have in the match decision?
5. Which unit [within the software lab] were you in at the time? Which unit was [the person assigned to shadow you / person you shadowed] in?
6. Did you or [the person assigned to shadow you / person you shadowed] have any specific objectives for the shadowing experience? If so, what were they?
7. Could you please walk me through the initial stages of the shadowing experience? How did you and [the person assigned to shadow you / person you shadowed] first make contact with one another? What did you discuss?
8. How many hours per week did [you / your shadow] spend together? How did the amount of time together vary over the course of the assignment? What was a typical day like?
9. Did [you / your shadow] form any new relationships as a result of the assignment? Did [you / your shadow] experience any change in existing relationships as a result of the assignment? Did the size of [your / your shadow's] workplace network change as a result of the assignment? Did the composition of [your / your shadow's] workplace network change as a result of the assignment? [For each question] If so, how did this happen?
10. Did [you / the person to whom you were assigned] introduce [your shadow / you] to any of [your / his or her] contacts? If so, who were they? Were they internal or external contacts? If internal, which unit did they work in? What was the context in which this introduction took place? What did you see as the benefits and risks of making the introduction?
11. [Was your shadow / Were you] able to form an independent relationship with these individuals? If so, how would you describe the relationship? How is this relationship similar to or different from the one [you / the person you shadowed] have with this individual?
12. Do you believe [your shadow / you] changed personally or professionally as a result of the experience? If so, how?
13. How well do you think the shadowing experience met your objectives? [Your shadow's objectives / the objectives of the person you shadowed]? The organization's objectives?
14. How did the shadowing experience conclude?
15. What level of contact have you maintained with [your shadow / the person you shadowed] since the assignment ended? How would you characterize the relationship today?
16. Do you believe that any changes to [your shadow's / your] network lasted beyond the assignment period? If so, how would you characterize the change? Do you believe [your shadow / you] have changed in other ways as a result of the experience? If so, how?
17. As you reflect on the shadowing experience as a whole, what do you think were the most helpful aspects? The least helpful aspects? What, if anything, would you change about the experience?