**Understanding the Building Blocks of On-the-Job Teacher Education: The Role of Physical Proximity in Work-Related Social Ties Among School Staff**

**Background and Context**

A key component of educating teachers to teach happens on the job, making schools important sites for teacher education (Hopkins & Spillane, 2014). After they enter the workforce, much of teachers' on-the-job learning takes place through advice- and information-seeking interactions with peers (Parise & Spillane, 2010; Shirrell, Hopkins, & Spillane, in press). These interactions with peers impact both teacher and school effectiveness (Bryk & Schneider, 2002; Frank, Zhao, & Borman, 2004; Jackson & Bruegmann, 2009; Pil & Leana, 2009; Sun, Loeb, & Grissom, 2016), making these interactions a key lever to improve educational effectiveness. Yet despite the importance of teachers' on-the-job interactions to educational effectiveness, we know little about the factors that predict these interactions. In order for schools and school systems to design systems that encourage those teacher interactions most likely to improve educational effectiveness, schools and school systems must first understand the patterns and predictors of those interactions. Putting research on teacher peer learning into practice, in other words, must begin with a better understanding of teachers' on-the-job interactions in schools.

**Objectives**

One potential influence on teacher peer interactions that has been particularly unexplored is the role of schools' *physical* infrastructures in predicting those interactions. Physical proximity has been shown to predict interactions in a variety of workplaces (Allen, 1977; Allen & Fustfeld, 1975; Backhouse & Drew, 1992; Caldeira & Patterson, 1987; Conti & Doreian, 2009; Kabo et al., 2015), yet we know little about whether proximity similarly predicts on-the-job interactions in schools. This study explores the relationship between physical proximity and work-related social ties among school staff. The analysis centers on the following research question: Are elementary school staff whose workspaces are located closer to one another, or whose paths cross more frequently in their day-to-day work within the school building, more likely to interact with one another about their work? Findings from this study will build our understanding of the predictors of teachers' on-the-job peer interactions, and help schools and school systems encourage those teacher interactions most likely to lead to improvements in educational effectiveness.

**Setting**

This study examines the relationship between physical proximity and work-related social ties in the 14 elementary schools in Auburn Park (a pseudonym), a mid-sized school district in the Midwestern United States. Auburn Park is a suburban district serving 5,900 elementary school students, mostly White (82%), with small populations of Latino/a (6%) and African American (5%) students; the district also serves a significant number of low-income students (see Table 1).

**Subjects**

Instructional staff (teachers and administrators) in the 14 elementary schools were surveyed in the spring of 2010, 2011, 2012, and 2013. Survey response rates were 81% in 2010 (n=331), 95% in 2011 (n=393), 94% in 2012 (n=375), and 94% in 2013 (n=384). Roughly 30% of survey respondents taught multiple grades, while roughly 20% held a leadership role in their schools (see Table 2).

**Research Design**
This descriptive study analyzed the associations between measures of physical proximity and the likelihood of ties between individuals. Exploratory analyses took advantage of the longitudinal nature of the data to examine the directionality of the relationship between physical proximity and social ties.

**Data Collection and Analysis**
Surveys asked elementary school instructional staff about their backgrounds, work-related interactions, and room numbers, among other areas. To measure work-related social networks, surveys used questions that were developed and validated in prior studies (Pitts & Spillane, 2009; Pustejovsky & Spillane, 2009). To gather network data, the surveys asked school staff to list the colleagues (up to 12) whom they considered their "close colleagues," as well as to list the colleagues whom they had turned to for instructional advice and information about various school subjects during the prior year.

Architectural floor plans were used to calculate two measures of physical proximity. The first measure was the within-building walking distances between workspaces; the second was the overlap of individuals' frequently traveled areas within school buildings, or "functional zones" (Kabo et al., 2014, 2015). Hierarchical latent space models (Sweet, Thomas, & Junker, 2013) were used to analyze the relationship between physical proximity and ties between pairs of school staff. The models included a number of node- and dyad-level covariates known to predict the likelihood of ties between school staff, including years of experience in education, network size, and indicators for teaching multiple grades, holding a leadership position, and teaching the same grade (at the pair level).

**Findings**
Within-building walking distance negatively predicts interactions about work, while the overlap of "functional zones" within school buildings positively predicts ties (see Tables 3 and 4). These patterns hold for both close colleague networks and for instructional advice networks in both math and language arts, even after controlling for a variety of factors that are generally associated with the likelihood of work related interactions.

Results of several additional analyses suggest that proximity predicts ties, not vice-versa. First, whether or not two staff members had a tie the prior year did *not* predict the pair moving closer to one another in the school building the following year. Second, proximity and ties were strongly associated for pairs that included at least one staff member that was entirely new to the field of education, and where prior ties between pairs were therefore unlikely to have determined proximity. Finally, analyses the controlled for whether pairs had a tie the prior year found the same general patterns of results as analyses that did not control for prior ties, demonstrating that proximity predicted the formation of *new* ties, not just those that existed previously.

**Implications for Practice**
In elementary schools, staff workplaces are often determined with little regard to the ways that physical proximity may shape interactions; instead, staff members are placed in proximity to one another based on grade level assignments or other considerations, such as available space. The

findings of this study argue for more careful consideration when assigning school staff to workspaces, as the physical proximity of school staff may play a significant role in who talks to whom about instruction.

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Table 1: Descriptive Statistics on Auburn Park Elementary Schools, 2012-2013

| | **Mean** | **SD** | **Min** | **Max** |
|---|---|---|---|---|
| School size (membership) | 418 | 92 | 250 | 601 |
| % White students | 82.2 | 7.8 | 66.9 | 92.3 |
| % Black students | 5.3 | 3.4 | 1.5 | 13.3 |
| % Hispanic students | 6.4 | 4.0 | 1.9 | 15.8 |
| % Asian students | 2.1 | 1.3 | 0.7 | 5.1 |
| % multiracial students | 3.6 | 1.4 | 1.7 | 6.0 |
| % FRPL students | 24.9 | 17.3 | 5.5 | 59.4 |
| % mobile students | 10.2 | 4.0 | 5.4 | 21.0 |
| % ELL students | 2.8 | 4.2 | 0 | 12.1 |
| % proficient on state reading test | 86.9 | 4.0 | 80.0 | 92.0 |
| % proficient on state math test | 82.2 | 5.6 | 71.0 | 92.0 |
| # teachers | 31 | 5 | 20 | 39 |
| % teachers w/ advanced degree | 57.8 | 14.5 | 34.5 | 80.8 |
| % White teachers | 98.3 | 2.5 | 93.8 | 100.0 |
| % Black teachers | 0.7 | 1.8 | 0 | 6.2 |
| % Hispanic teachers | 1.1 | 1.8 | 0 | 4.7 |

n=14

Table 2: Descriptive Network Statistics, Auburn Park, 2010-2013

| | **2010** | **2011** | **2012** | **2013** |
|---|---|---|---|---|
| **Individual (Node) Level** | | | | |
| Taught multiple grades | 0.32 | 0.30 | 0.27 | 0.29 |
| | (0.47) | (0.46) | (0.45) | (0.46) |
| Leadership role | 0.21 | 0.20 | 0.19 | 0.17 |
| | (0.40) | (0.40) | (0.39) | (0.37) |
| Years of experience | 12 | 12 | 12 | 11 |
| | (9) | (9) | (9) | (9) |
| | | | | |
| **Pair (Dyad) Level** | | | | |
| Same grade | 0.41 | 0.39 | 0.38 | 0.37 |
| | (0.49) | (0.49) | (0.49) | (0.48) |
| Distance (walking distance) | 222 | 224 | 223 | 223 |
| | (83) | (89) | (81) | (78) |
| Distance (zone overlap) | 259 | 249 | 242 | 236 |
| | (124) | (130) | (123) | (121) |
| | | | | |
| **Network** | | | | |
| Network size | 24 | 28 | 27 | 28 |
| | (8) | (5) | (6) | (5) |
| | | | | |
| **Nodes, n** | 332 | 393 | 373 | 389 |
| **Dyads, n** | 8,312 | 10,928 | 9,976 | 10,722 |
| **Networks, n** | 14 | 14 | 14 | 14 |

Note: Distance measures are in feet units. For purposes of this table, functional zones for zone overlap measures are defined as the paths between individual workspaces, principals' offices, and building entrances/exits.

Table 3: Associations Between Walking Distance and Ties in Close Colleague, Mathematics, and Language Arts Networks, Auburn Park, 2010-2013

| | **2010** | **2011** | **2012** | **2013** |
|---|---|---|---|---|
| **Colleague Networks** | | | | |
| Walking distance | **-0.439** | **-0.450** | **-0.506** | **-0.435** |
| **Math Networks** | | | | |
| Walking distance | **-0.628** | **-0.617** | **-0.590** | **-0.691** |
| **Language Arts Networks** | | | | |
| Walking distance | **-0.452** | **-0.541** | **-0.486** | **-0.579** |

Notes: Estimates are from HLSM models that also control for teaching multiple grades, leadership role, and years of experience in education for tie senders and receivers; at the dyad level, teaching the same grade level; and network size. Bold estimates can be distinguished from zero with 95% confidence.

Table 4: Associations Between Zone Overlap and Ties in Close Colleague, Mathematics, and Language Arts Networks, Auburn Park, 2010-2013

*Panel A: Colleague Networks*

| **Locations** | **2010** | **2011** | **2012** | **2013** |
|---|---|---|---|---|
| Exit, restroom | **0.229** | **0.311** | **0.316** | **0.298** |
| Lunchroom, principal | **0.269** | **0.361** | **0.373** | **0.326** |

*Panel B: Math Networks*

| **Locations** | **2010** | **2011** | **2012** | **2013** |
|---|---|---|---|---|
| Exit, restroom | **0.160** | **0.389** | **0.272** | **0.542** |
| Lunchroom, principal | **0.361** | **0.387** | **0.326** | **0.481** |

*Panel C: Language Arts networks*

| **Locations** | **2010** | **2011** | **2012** | **2013** |
|---|---|---|---|---|
| Exit, restroom | **0.210** | **0.318** | **0.257** | **0.437** |
| Lunchroom, principal | **0.265** | **0.387** | **0.284** | **0.370** |

Notes: Estimates are from HLSM models that also control for teaching multiple grades, leadership role, and years of experience in education for tie senders and receivers; at the dyad level, teaching the same grade level; and network size. Bold estimates can be distinguished from zero with 95% confidence.