The health implications of contextual exposure:
The third way between residential neighborhood and activity space

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Abstract

Research on neighborhood effect on health has increasingly paid attention to the potential influence of activity space, which assumes that individuals conduct daily activities outside residential neighborhoods. Little is known about whether this assumption undermines our understanding of how context matters and even less is about whether neighborhood effect varies by individual activity space experience. Using a unique dataset collected in the Philadelphia metropolitan area, we identify four types of activity space experience, namely incongruent residents, congruous residents, stayers, and mislaid residents. The preliminary findings suggest that (1) approximately 15 percent of respondents do not have an activity space, (2) individual characteristics are strongly associated with activity space experience, such as education, poverty, and nativity, and (3) the effect of residential neighborhood disadvantage on health is most profound among incongruent residents and congruous residents enjoy the beneficial effect of social capital on health most.

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Introduction

The past few decades have witnessed a growing interest in how an individual's exposure to various residential neighborhood characteristics (e.g., poverty, co-ethnic density, and unemployment) affects one's health, which is known as the neighborhood effects on health (Acevedo-Garcia and Osypuk 2008a, 2008b; Culhane and Elo 2005; Diez-Roux 2001; Kramer and Hogue 2009; Osypuk and Acevedo-Garcia 2010; Robert 1999). This knowledge stream defines one's residential neighborhood with an existing administrative unit, such as census tract or census block group, links contextual and/or compositional variables of a unit to individual data, and then investigates the association between one's health and the contextual or compositional variables. The empirical evidence suggests that one's residential neighborhood plays a role in determining one's health outcomes even after controlling for individual differences in socioeconomic status and demographic features (Diez-Roux and Mair, 2010).

The aforementioned analytic approach to neighborhood effect has been criticized for the following weaknesses (Matthews and Yang, 2013; Browning and Soller, 2014; South and Crowder, 2010): (1) it assumes that individual health outcomes are only shaped by residential neighborhoods; (2) it overlooks the fact that individuals are exposed to different contexts due to different daily routines; and (3) the pre-existing administrative unit is not a realistic geography that captures potential risk factors for health. To address these issues, many scholars have adopted the concept of activity space—a geographic area where individuals perform their daily activities—and investigated if the characteristics of activity space are associated with health outcomes (Vallée et al., 2010; Zenk et al., 2011; Sharp et al., 2015; Kimbro et al., 2017). This new inquiry often demands detailed data on one's daily routines (or travel logs) and the differences between one's residential neighborhood and activity space are anticipated to have implications for one's health outcomes (Sharp et al., 2015). While activity space is conceptually important, the extant finding about its relationship with health have not been as conclusive as those reported in the conventional neighborhood effect research (Kimbro et al., 2017).

While the attention to activity space improves our understanding of the relationship between contextual exposure and health, it is largely based on two assumptions: (1) every individual has both residential neighborhood and activity space, and (2) activity space is substantively different from residential neighborhood. The second assumption has been explored in the literature (Zenk et al., 2011; Krivo et al., 2013); however, to our knowledge, little research has questioned the first assumption and even less has attempted to investigate if this specific assumption alters the conclusions about how the exposure to contextual characteristics affects health. Using a unique dataset in which respondents were asked whether and where they spend most of their time when they are not home, this proposed study aims to tackle the first assumption by answering three interrelated research questions: First, does everyone have an activity space outside his/her residential neighborhood? Second, what are the socioeconomic and demographic differences among individuals with different activity space experience? Third, how

do the relationships between neighborhood characteristics and health vary by activity space experience?

Drawing from the research questions, we propose the following hypotheses: *(H1): Individuals with better socioeconomic status and health are more likely to experience incongruent activity space. (H2) Residential neighborhood characteristics are more strongly associated with health among congruent residents and stayers than among their counterparts with incongruent activity space. (H3) The effect of individual social capital on health is stronger among congruent residents and stayers than individuals with other activity space.*

Data and Methods

The 2010 Southeastern Pennsylvania Household Health Survey (SPHHS) is the main data source. SPHHS is a cross-sectional survey in the Philadelphia metropolitan area and has been conducted biennially since 1991 through telephone interviews. The target population are individuals aged 18 and older and the elderly (over 65) are oversampled. Beyond individual socioeconomic and demographic features, the survey aims to collect information on health status, personal health behaviors, and access to, utilization of and quality of area health services. Importantly, the census tract and ZIP code where a respondent resides are available in the data, which will be used in this study. In this study, there are overall 9,849 respondents in the analysis.

Dependent variable: We use self-rated health (SRH) as the dependent variable. While the original measurement is a five-level Likert Scale from excellent to poor, we follow the conventional approach to dichotomize SRH into the fair/poor (reference group) and excellent/very good/good group (coded 1).

Activity space experience: Respondents were asked where they spend most of their time when they are not home. The respondents could choose the answer of "Do not go out," if they do not have an activity space. Should a respondent report an activity space, s/he would provide a ZIP code to indicate where her/his activity space is. Comparing respondents' residential ZIP codes with their answers to this question, we are able to classify respondents' activity space experience into four groups: *Incongruent residents* are those reporting an activity space ZIP code that is different from residential ZIP code (N=4,357); *congruous residents* refer to individuals spend most of their time in their residential ZIP code (N=1,988) (i.e., activity space ZIP code is the same with residential one); *stayers* are individuals who reported "Do not go out" (N=1,513 (i.e., no activity ZIP code); and the last group, *mislaid residents*, is those who reported an activity space but failed to provide a ZIP code (N=1,991). While this variable serves as the key independent variable, when investigating the socioeconomic and demographic differences among the four groups, the incongruent residents are used as the reference group (see below for details).

Socioeconomic and demographic variables: We consider the following socioeconomic variables in the analysis: *educational attainment, employment status, poverty, and insurance status.* Educational attainment is divided into five categories: less than high school (reference group), high school graduate, some college, college graduate, and post college degree.

Employment status has three groups, namely full-time/part-fime employed (reference group), unemployed, and others (including those who are retired, unable to work, students, and homemakers). Poverty and insurance status are both binary variables. Individuals with income lower than the federal poverty line are coded 1 (i.e., poor), otherwise 0. Similarly, respondents having any type of insurance are coded 1 (i.e., insured), in contrast to those without insurance.

We include five demographic variables in the analysis: *age, gender, race/ethnicity, marital status, and nativity.* Age is treated as a continuous variable measured in years and gender is a binary variable in that females are coded 1. Race/ethnicity considers four groups: non-Hispanic whites (reference group), non-Hispanic blacks, Hispanics, and non-Hispanic others. Marital status is categorized into three groups: married or living with a partner (reference group), widowed/divorced/separated, and single. Foreign-born respondents are coded 1 in nativity, otherwise 0.

Neighborhood variables: Neighborhood disadvantage is a composite score generated from a factor analysis of five indicators of the socioeconomic characteristics of residents in a neighborhood, including poverty rate, unemployment rate, proportion of female-headed households, proportion of residents with a bachelor's degree, and proportion of families with income higher than 75,000 dollars. One factor is generated from the principle component factor analysis and a larger score indicates a higher level of neighborhood disadvantage.

Neighborhood social capital is also a factor score based on respondents' answers to five questions: 1) How many local groups or organizations do you participate? 2) How likely do you think people in the neighborhood are willing to help each other (rated on a scale of 1 "never" to 5 "always")? 3) Have people in the neighborhood ever worked together to improve the neighborhood? 4) Do you agree that you belong to and are part of the neighborhood (rated on a scale from 1 "strongly disagree" to 4 "strongly agree")? 5) Do you agree that most people in the neighborhood can be trusted (rated on a scale from 1 "strongly disagree" to 4 "strongly agree")? The principle component factor analysis suggests that one factor is sufficient to capture the concept of social capital. A larger factor score value means stronger social capital embedded in a respondent's neighborhood networks.

We also include two indicators of the availability and quality of facilities in the neighborhoods. First, the survey asked the respondents to rate the quality of groceries available in the stores in the neighborhood on a four-point scale ranging from "poor" to "excellent". Second, the respondents rated on how often they use public recreation facilities in their neighborhoods, such as public swimming pools, parks, schools, walking trails, bike paths or recreation centers. The frequency of facility usage ranges from 1 "Never" to 6 "More than once a week." In addition, we code it 0 if a respondent said there is no public recreation facilities in his/her neighborhood.

Analytic strategy: In order to answer the research questions, our analytic strategy has two stages. The first stage is to understand whether there is any significant socioeconomic and demographic difference among the four types of activity space experience. In addition to the

basic descriptive statistics, we implement multinomial regression analysis (incongruent residents as the reference group) to better understand the differences across the groups. The second stage is to examine if the effects of residential neighborhood characteristics on SRH vary across the four groups. The main analytic approach is logistic regression with cluster-adjusted standard errors (as a residential neighborhood may have multiple respondents).

Preliminary Findings

Table 1 shows the multinomial regression results and we summarize two findings. First, there are some significant socioeconomic and demographic differences between incongruent residents and individuals with other activity space experience. Specifically, as age increases, it is less likely to be congruous residents or mislaid residents. Educational attainment seems to have a consistent impact on activity space experience. Higher educational attainment is associated with a higher odds of being incongruent residents, who spent most of their time in another ZIP code. By contrast, employment status constrains an individual activity space experience as being employed, whether full-time or part-time, lowers the odds of being congruous residents, stayers, or mislaid residents. This constraining effect is also observed for poverty.

Second, marital status does not have a strong relationship with activity space experience, except for that being single is more likely to be mislaid residents than incongruent residents. Third, race/ethnicity has little impact on mislaid resident; however, non-Hispanic blacks are less likely to be congruous residents or stayers. Moreover, Hispanics are more likely to be stayers than incongruent residents. Foreign-born respondents are more likely to be stayers or mislaid residents, which may be a result of language barrier.

The logistic regression results are summarized into Table 2. As the goal of this analysis is to understand if the impacts of residential neighborhood characteristics differ by activity space experience, we focus on our discussion on the variables related to residential neighborhoods. We first find that the adverse impact of neighborhood disadvantage on SRH is only significant for incongruent residents. This finding, to some extent, challenges the literature that regularly suggests that neighborhood disadvantage is detrimental to health. Our finding indicates that for individuals who do not often go outside their residential neighborhoods (i.e., congruous residents and stayers), neighborhood disadvantage does not affect their health.

Second, neighborhood social capital score benefits SRH only for congruous residents, individuals who perform daily activities in areas nearby their residence. This finding is interesting and follows theoretical expectations as incongruent residents may not develop strong social capital within their residential neighborhoods and stayers barely interact with neighbors. Consequently, social capital does not play a role in determining SRH.

Third, regardless of activity space experience, public facility in residential neighborhoods has a positive effect on SRH, which suggests that resources in local neighborhoods plays a critical role in promoting population health. This finding echoes the underinvestment argument

that the unequal distribution of resources across neighborhoods leads to neighborhood health disparities.

Conclusions

The goal of this study is to understand if the assumption that everyone has an activity space holds and to investigate whether socioeconomic and demographic features determine one's activity space experience. We ultimately explore whether different activity space experience affects our understanding of how residential neighborhood characteristics affects health. Our preliminary findings lead us to the following three conclusions: (1) At least 15 percent of our respondents do not go out of their residential neighborhood and more than 20 percent report that they spent most of their time nearby their residence. This finding challenges the implicit assumption of activity space research. (2) We identify several important socioeconomic and demographic differences across groups, such as poverty, nativity, and educational attainment. This finding suggests that one's activity space experience is likely to be a selection process and it may not be appropriate to assume that everyone has similar activity space experience. (3) The association between residential neighborhood characteristics and SRH differs by activity space experience. This finding highlights the importance of disentangling one's activity space experience when exploring neighborhood effects.

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Table 1. Multinomial Logistic Regression Models Modeling Activity Space Experience

	Congruous Residents vs. Incongruent Residents	Stayers vs. Incongruent Residents	Mislaid Residents vs. Incongruent Residents
	(1)	(2)	(3)
Age	-0.039***	-0.014	-0.039***
	(0.010)	(0.012)	(0.010)
Age squared	0.000***	0.000***	0.001***
	(0.000)	(0.000)	(0.000)
Female	-0.073	-0.050	-0.366***
	(0.061)	(0.074)	(0.060)
Non-Hispanic Black	-0.446***	-0.211*	-0.122+
	(0.075)	(0.086)	(0.073)
Hispanic	-0.043	0.368*	0.159
	(0.146)	(0.166)	(0.146)
Other	-0.482**	-0.044	0.008
	(0.162)	(0.184)	(0.143)
Divorced/Widowed/Separated	-0.063	-0.055	-0.010
	(0.080)	(0.088)	(0.080)
Single or other	0.096	-0.015	0.238**
	(0.076)	(0.093)	(0.075)
Foreign born	0.227+	0.431**	0.413***
	(0.119)	(0.139)	(0.113)
High school graduate	-0.433**	-0.792***	-0.399**
	(0.134)	(0.134)	(0.138)
Some college	-0.776***	-1.004***	-0.622***
	(0.141)	(0.143)	(0.144)
College graduate	-0.882***	-1.270***	-0.619***
	(0.142)	(0.149)	(0.144)
Post college	-1.049***	-1.806***	-0.954***
	(0.148)	(0.165)	(0.151)
Unemployed	1.071***	2.021***	0.821***
	(0.107)	(0.127)	(0.113)
Retired/Unable/Students/Homemaker	1.079***	2.230***	0.878***
	(0.074)	(0.092)	(0.075)
Poverty	0.237*	0.348**	-0.224+
	(0.109)	(0.114)	(0.120)
Insured	-0.388***	-0.356**	-0.317**
	(0.112)	(0.137)	(0.115)
Constant	0.633*	-1.346***	0.353
	(0.310)	(0.382)	(0.313)
N	9,707	9,707	9,707
Log-likelihood	-11328	-11328	-11328
R square	0.0973	0.0973	0.0973
Chi-square	2443	2443	2443
Degrees of freedom	51	51	51

*** $p<0.001$, ** $p<0.01$, *$p<0.05$, + $p<0.1$

Table 2. Logistic Regression Models Examining the Associations between Neighborhood Characteristics and Good Health by Activity Space Experience

	Incongruent Residents	Congruous Residents	Stayers	Mislaid Residents
	(1)	(2)	(3)	(4)
Non-Hispanic Black	-0.036	-0.197	-0.090	-0.348
	(0.194)	(0.244)	(0.231)	(0.277)
Hispanic	-0.329	-0.108	-0.401	-0.875*
	(0.332)	(0.406)	(0.483)	(0.371)
Other	0.648	0.513	-0.522	0.241
	(0.438)	(0.433)	(0.428)	(0.726)
Age	-0.130***	-0.097**	-0.041	-0.088**
	(0.035)	(0.032)	(0.029)	(0.031)
Age squared	0.001***	0.001**	0.000+	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
Female	0.114	0.060	0.263	-0.108
	(0.144)	(0.175)	(0.176)	(0.183)
Divorced/Widowed/Separated	-0.301+	-0.500*	-0.144	-0.130
	(0.160)	(0.209)	(0.213)	(0.222)
Single or other	-0.204	-0.372+	-0.182	0.189
	(0.182)	(0.219)	(0.222)	(0.253)
Foreign-born	0.184	1.065*	0.198	0.308
	(0.292)	(0.424)	(0.372)	(0.291)
High school graduate	-0.040	0.266	0.211	0.170
	(0.319)	(0.303)	(0.245)	(0.325)
Some college	0.054	0.329	0.504+	0.107
	(0.330)	(0.332)	(0.274)	(0.354)
College graduate	0.918**	1.293***	1.074**	0.418
	(0.349)	(0.359)	(0.338)	(0.363)
Post college	1.107**	0.989*	0.715+	1.051*
	(0.351)	(0.432)	(0.413)	(0.443)
Unemployed	-0.475	-0.186	-0.899*	-0.401
	(0.295)	(0.328)	(0.394)	(0.317)
Retired/Disabled/Students/Homemaker	-1.175***	-0.977***	-1.843***	-0.654**
	(0.175)	(0.225)	(0.296)	(0.212)
Poverty	-0.525*	-0.182	-0.368	-0.493
	(0.239)	(0.273)	(0.249)	(0.335)

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Insured	0.410	0.059	-0.354	0.330
	(0.265)	(0.306)	(0.367)	(0.348)
Neighborhood disadvantage score	-0.193*	-0.141	-0.078	-0.138
	(0.087)	(0.113)	(0.116)	(0.121)
Neighborhood social capital score	0.104	0.338***	0.116	0.102
	(0.070)	(0.094)	(0.089)	(0.097)
Grocery store	0.478***	0.140	0.248*	0.092
	(0.077)	(0.106)	(0.107)	(0.126)
Public facility	0.100*	0.126**	0.135**	0.232***
	(0.040)	(0.045)	(0.052)	(0.053)
Constant	3.307**	3.726***	1.760	3.029**
	(1.016)	(0.979)	(1.100)	(0.988)
N	3,669	1,652	1,153	1,547
Log-likelihood	-1026	-606.5	-579.3	-586.2
R squared	0.179	0.183	0.155	0.118
Chi square	304.8	199.9	153.8	129.4
Degrees of freedom	21	21	21	21

*** $p < 0.001$, ** $p < 0.01$, *$p < 0.05$, + $p < 0.1$