Neighborhood diversity and the creative class in Chicago

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Neighborhood diversity and the creative class in Chicago

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A B S T R A C T

Richard Florida’s creative class theory posits that highly skilled workers with creative- or knowledge-intensive occupations are particularly sensitive to ‘quality of place’, a key component of which is an open and tolerant attitude toward different peoples, cultures, and lifestyles. While diversity, as a proxy for tolerance, has proven to be a relatively weak pull-factor at the inter-metropolitan level, the potential role of neighborhood-level diversity in the residential location of creative class workers has yet to be explored empirically. In this study we use ordinary least squares (OLS) regression and geographically weighted regression (GWR) to test the hypothesis that there exists significant associations between particular types of neighborhood diversity (i.e., sexual orientation, language, race, and income) and the proportion of workers with specific creative class occupations. The results of our Chicago case study suggest a significant positive relationship between the creative class and the proportion of gay households and income diversity, but not racial or linguistic diversity. Overall, diversity appears to play a limited role in predicting where creative class workers reside, though the GWR analysis indicated substantial spatial variation in the strength of association between neighborhood diversity and creative class share across the study area.

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1. Introduction

A central tenant of Richard Florida’s widely critiqued creative class theory is that highly skilled workers with creative- and knowledge-intensive occupations (e.g., science and engineering, technology, art and media, business and finance, law, medicine) are drawn to particular cities and neighborhoods primarily on the basis of so-called ‘quality of place’ amenities (Florida, 2002). Thick labor markets, active social, cultural and entertainment scenes, and a tolerant atmosphere as approximated using indices of diversity are typically cited among the primary pull factors (Clark, Lloyd, Wong, & Pushpam, 2002; Florida, 2002, 2005, 2008). Among this rich assortment of territorial assets, diversity is often the most controversial in terms of its ability to attract creative class workers and catalyze economic growth (Anderson, Bugge, Hansen, Isaksen, & Raunio, 2010; Fainstein, 2005; Marlet & Van Woerkens, 2005; Peck, 2005; Scott, 2006).

Florida has suggested that creative class workers may be attracted to diverse communities for two primary reasons. First, diversity may be interpreted as a sign of a community’s openness and tolerance of difference (Florida, 2012, p. 293–94). This may be a particularly salient consideration among creative class workers moving between cities, regions, and even countries. Migrants may interpret diverse cities and neighborhoods as more welcoming to ‘outsiders’, with lower barriers to integration and acceptance, regardless of sexuality, race, and ethnicity. Second, diversity may enhance the vibrancy of a community in terms of the variety of people, the potential for interesting and productive interactions, and the number and variety of cultural products and amenities available for local consumption. Florida suggests that creative class workers crave variety: ethnic restaurants, diverse music scenes and venues, and eclectic retail shops; all of which are expected to benefit from a diverse population and a healthy ‘people climate’ (Florida, 2002). Similarly, Zukin (2008, 2009, 2011) argues that diversity may play a key role in establishing authenticity and a sense of place; characteristics that Florida proposes are particularly valued by creative class workers.

Over the past decade, a growing body of literature has examined the potential connections between a variety of urban amenities and the residential locations of creative or knowledge workers. Much of this research has focused on the migration of highly skilled workers between, rather than within, cities. The inter-urban focus of these
studies stems from the notion that creative class workers drive economic growth, and thus their attraction and retention should be a foremost priority among local policymakers (Florida, 2002; Florida, Mellander, & Stolarik, 2008). Using a survey of creative class workers in Germany, Zenker (2009) found that members of Florida’s ‘supper creative core’ (i.e., members of the creative class with particularly creativity-intensive occupations such science, design, art/media) were more strongly attracted by a city’s ‘urbanity and diversity,’ than were workers with non-creative class occupations. Based on a survey of 13 European cities, Musterd and Gritsai (2013) concluded that ‘soft conditions’, defined as a combination of weather/climate, cultural diversity, tolerance, friendliness, and diversity of the built environment, among other variables, may be more effective at retaining, rather than attracting, highly skilled workers. A number of other studies have indicated that employment opportunities remain the top pull factor at the inter-urban scale, with socio-cultural amenities, aesthetics, and diversity generally having less influence (Boren & Young, 2013; Brown & Mceynynski, 2009; Marlet & Van Woerkens, 2009; Scott, 2010).

With the majority of creative class research focused on inter-
urban migration, there remains a lack of empirical data on the re-
relationships between diversity and the creative class within cities. Although much of Florida’s expose on diversity and the creative class has focused on the city or region, he has also made explicit references to diversity at the neighborhood scale. He concludes from a series of interviews and focus group discussions that creative class workers “…gravitate to the indigenous street-level culture found in Soho [in New York City] … They look for places with visible signs of diversity – different races, ethnicities, sexual orientations, income levels, and lifestyles” (Florida, 2005, p. 164). In accordance with the creative city paradigm, creative class workers are thus expected to exhibit a distinct preference for older, established neighborhoods that offer an urban lifestyle with stimulating experiences and diversity of both people and the built environment (Clark et al. 2002; Florida, 2005; Lloyd, 2002; Zukin et al. 2009). Few studies, however, have empirically tested these hypotheses. Lawton, Murphy, and Redmond (2013) investigated the residential preferences of creative class workers in Dublin, Ireland using an online survey. The authors concluded that ‘classic’ location factors such as housing cost and distance to work were a more important consideration for creative class workers than were leisure and cultural amenities. Utilizing a web-based revealed-preference survey of knowledge-workers in Tel-Aviv, Frenkel, Bendit, and Kaplan (2013a), examined a large set of potential factors in intra-urban residential choice, and found that housing affordability, the educational level of residents, travel time to the CBD and to work, density, and educational and cultural land use were among the most important considerations. Comparing creative and non-
creative households in Bangkok, Thailand, Mansury, Tontsirin, and Anantsuksomsri (2012) concluded that creative households were more likely to reside near rail stations, ‘top schools’, shopping malls, and public parks within the city’s ‘inner-ring.’ Crucially, to the authors’ knowledge no study has yet empirically examined diversity as a potential factor in the intra-urban residential location of creative class workers, despite the claim that openness and tolerance are key aspects of the creative class ethos (Florida, 2002; Thomas & Darnton, 2006).

In this study we employ ordinary least square regression (OLS) and geographically weighted regression (GWR) to explore the intra-urban spatial associations between neighborhood diversity and the creative class in Chicago. GWR has been used extensively over the past two decades in a wide variety of fields to investigate the spatial variation in the relationships between dependent and independent variables (Fotheringham, Brunsdon, & Charlton, 2002). In contrast to standard linear regression, which provides a single global model based on all available data points, GWR fits a regression model for each individual observation. In doing so, GWR allows the researcher to ‘excavate down’ to the local level, where fine-grained variations in the strength and direction of the relationships between variables can yield insight into the nature and causal mechanisms of the phenomena under study. The utility of GWR as an exploratory tool has been demonstrated in areas as diverse as public health (e.g., Chalkias et al. 2013; Gilbert & Chakraborty, 2011), ecology (e.g., Propastin, 2012; Wang, Ni, & Tenhunen, 2005), transportation and land use (e.g., Cardozo, García-Palomares, & Gutierrez, 2012; Du & Mulley, 2012; Dzialdow, Powe, & Alvanides, 2015; Lloyd & Shuttleworth, 2005;), crime (e.g., Cahill & Mulligan, 2007; Wheeler & Waller, 2009), housing (e.g., Díaz-Garayúa, 2009; Yu, Wei, & Wu, 2007; Zou 2015), and environmental studies (e.g., Buyantuyev & Wu, 2010; Hu et al. 2013; Tu, 2011). While GWR has been employed recently to explore neighborhood diversity in relation to homicide rates (Graif & Sampson, 2009) and housing values (Díaz-Garayúa, 2009), to our knowledge this study will represent the first to examine the spatially varying relationships between neighborhood diversity and the creative class. GWR and other locally-weighted regression techniques show great promise in deepening our understanding of the creative-knowledge economy and its socio-spatial artifacts.

In this paper we address three primary research questions. First, is there a significant association between neighborhood diversity and the proportion of workers with creative class occupations at the census tract level throughout the Chicag area? Second, if signif-
nificant associations exist, do they vary by type of diversity (i.e., sexual orientation, race, language, income) and creative class occupational group (i.e., creative class total; super creative core; computer, science, & engineering occupations; education, training, & library; and arts, design, & entertainment)? Third, do associa-
tions between neighborhood diversity and the proportion of workers employed in creative class occupations exhibit spatial nonstationarity (i.e., spatial variation) across the study area? In answering these three questions we aim to test whether one of the professed core values of the creative class – the desire for open, tolerant, and diverse communities – is reflected in the reality of Chicago’s urban landscape. The tendency of highly skilled workers to spatially associate with certain types of diversity at the intra-
urban scale may also provide some indication as to the future tra-
jectory of social integration (or polarization) in the post-modern metropolis. A lack of spatial association, for example, would suggest the potential for heightened segregation and spatial inequality as cities pursue policies to increase their creative class share. Alternatively, strong spatial associations between neighborhood diversity and the creative class would not only support Florida’s hypothesis at the intra-urban scale; it may also reveal a pattern of ‘creative gentrification’ that poses its own unique challenges.

2. Study area and methods

2.1. Chicago

The study area included 1983 census tracts within the city of Chicago and seven surrounding counties in northwestern Illinois: Cook (of which the City of Chicago is the county seat), Lake, McHenry, Kane, DuPage, Kendall, and Will (Fig. 1). Together, the seven central counties of ‘Chicagoland’ were home to 8.51 million people (89 percent of the total Chicago metropolitan area popula-
tion). The Chicago region is the third most populous urban agglomeration in the United States, and as an ‘Alpha world city’ (GaWC, 2012), is considered one of the world’s leading economic centers. Since the 1970s, Chicago’s economy has undergone a
dramatic transformation from primarily industrial to service-based (Doussard, Peck, & Theodore, 2009). In Florida’s (2012) most recent ranking of metropolitan areas by percent creative class employment, Chicago was ranked 45th among 361 metros with 35.1 percent of its workforce engaged in creative class occupations.

Demographically, Chicago consists of a diverse patchwork of urban and suburban neighborhoods that vary considerably in ethnic, racial, and economic composition (Chipman, Wright, Ellis, & Holloway, 2012). The diversity of Chicago neighborhoods also vary considerably, though income and housing diversity have been found highest among the inner-ring ‘blue-collar’ suburbs (Talen, 2006). Indications are that diversity — particularly racial diversity — has been on the rise in recent decades, though highly segregated inner-city black communities have undergone among the least amount of change (Holloway, Wright, & Ellis, 2012).

Since the early 20th century, the city of Chicago has served as a model of urban social patterns and dynamics, as exemplified by the work of the ‘Chicago School’ of urban sociology at the University of Chicago (Park & Burgess, 1925). More recently, Chicago has served as one of the world’s premier urban laboratories in regard to post-industrial economic and social restructuring, with issues of urban redevelopment, globalization, gentrification, inequality, and social mixing comprising substantial arenas of inquiry (e.g., Charles, 2014; Lloyd, 2002; Sternberg & Anderson, 2014). This study follows in the tradition of using Chicago and surrounding environs as a ‘model city’ with the crucial understanding that the region’s unique history, culture, and position within the global urban hierarchy will necessarily impact observed spatial patterns and relationships. Consider, for example, Chicago’s rapid growth and industrial ascendency during the 19th and early 20th centuries. This growth was fueled in large part by immigration, producing a rich mosaic of ethnic enclaves and communities (Keating, 2008). Despite substantial socio-economic and demographic changes over the past century, Chicago has remained ‘a city of neighborhoods.’ Unfortunately, today many areas of Chicago are also characterized by socioeconomic and racial polarization (Sampson, 2013). The impacts of

Fig. 1. Select neighborhoods and municipalities within the Chicago study area.
disinvestment prompted by deindustrialization, and reinvestment following economic restructuring and heightened globalization, have not been felt evenly throughout the Chicago area (Lipman, 2002; Sampson, 2013). This imbalance of wealth, growth, and power has resulted in what may be described as a ‘dual city’ (Mollenkopf & Castells 1991), in which “upscale, gentrified neighborhoods and redeveloped downtowns catering to arts, tourism, and leisure [exist] alongside isolated, poor African-American, Latino, and immigrant neighborhoods” (Lipman, 2002, p. 386). Given these tensions, and the on-going challenge of advancing social equality and equity throughout the region, the Chicago area presents an ideal case study in which to begin probing the potential connections between neighborhood diversity and the expanding creative-knowledge economy.

2.2. Data collection and processing

A total of four dependent variables, representing four measures of diversity, and 13 independent variables, including five creative class occupational groupings and seven control variables, were selected for inclusion in the study. Demographic, socio-economic, and occupational data used to estimate both diversity and creative class occupation by census tract were obtained from the U.S. Census Bureau (U.S. Census Bureau 2012). All census data consisted of five-year averages (2008–2012). Florida (2002, 2012) identified two major groups of creative class workers: the super creative core and creative professionals. The super creative core, representing individuals with computer/math, architecture/engineering, life/physical/social science, education/training/library, and arts/design/entertainment/sports/media occupations, is expected to include the most creativity-intensive workers. Creative professional occupations, such as management, business, finance, legal, health care, and high-end sales, are also expected to require a high degree of creativity, though perhaps less than those of the super creative core. Although Florida’s definition and classification scheme has become the standard in creative city research, several authors have offered insightful critiques of his model. Most notably, they have pointed to the difficulty in defining and assessing creativity, identifying creative occupations, and the potential redundancy of the concept, which is often closely linked to measures of ‘human capital’ based on educational attainment rather than occupation (Glaser, 2005; Markusen, 2006; Markusen, Wassall, DeNatale, & Cohen, 2013; Markusen 2006) further addressed the “fuzziness” of the creative class concept, highlighting the potential for creative jobs to exist among so-called ‘non-creative’ occupations, while positions requiring relatively little creativity can often be found among the ‘creative’ occupations. Indeed, as Reese, Faist, and Sands (2010) observed, “the operationalization of the creative class ... is at best a subjective enterprise” (p. 348). With these limitations in mind, and while acknowledging that other creative class formulations exist (see Markusen et al. 2008; McGranahan & Wojan, 2007), we have elected to use Florida’s (2002, 2012) occupational definitions in this study for consistency with previous analyses and the broader theoretical framework within which Florida attempts to unite diversity, quality of place, and the creative class. Our analysis of specific occupational groups (discussed below) within the ‘creative core’, in addition to the ‘creative class’ and ‘creative core’ in general, however, was done in recognition of the potential for substantial variation within these broad categories.

In Rise of the Creative Class, Florida ranked U.S. metropolitan areas according to the proportion of workers with creative class occupations. These data were obtained from the Bureau of Labor Statistics (BLS) Occupational Employment Survey (OES). BLS data, however, is not available at the census tract level; thus we used comparable occupational data from the U.S. Census Bureau’s American Community Survey (ACS). Florida (2013) recently used this dataset to explore the intra-urban geographies of the creative class in several large U.S. cities. Additionally, the BLS and U.S. Census currently use the same occupational categories derived from the 2010 Standard Occupational Classification (SOC). In the ACS, the major occupational group ‘management, business, science and arts occupations’ constituted the closest creative class equivalent, while three sub-groups, ‘computer, engineering, and science occupations’ (CES), ‘education, training, and library occupations’ (ETL), and ‘arts, design, entertainment, sports, and media occupations’ (ADE) were used collectively to represent the super creative core. The three super creative core sub-groups were assessed both together and independently in the modeling procedures.

Specific measures of diversity included sexual orientation (i.e., the percent of gay households in each census tract), race, dominant language spoken at home, and median household income. Racial, linguistic, and income diversity for each census tract were calculated using the Simpson’s Index of Diversity:

\[ y = 1 - \sum_{k} \left( \frac{n_k}{N} \right)^2 \]  

(1)

Where \( n \) is the number of residents of a particular category, and \( N \) is the total number of residents per census tract (Simpson, 1949). The index varies from 0 to 1, with higher values indicative of higher diversity. The index measures the likelihood that two individuals selected at random will belong to separate racial/linguistic/income categories. Race was divided into seven census-defined categories: White, Black, Native American, Asian, Pacific Islander, Hispanic, and ‘other race.’ Linguistic diversity was estimated using eight categories based on the seven most common languages spoken at home within the Chicago study area (i.e., English, Spanish, Polish, Chinese, Tagalog, Korean, and German) plus an additional category to represent all other languages. The income diversity index was based on four consolidated census income categories representing low income ($0–24.9 k), low middle income ($25–59.9 k), high middle income ($60–99.9 k), and high income (100 k+) households. The four income categories were chosen to align as close as possible with the study area’s household income quartiles.

In addition to assessing diversity for each individual census tract separately, a geoprocessing model was developed within the ArcGIS™ v. 10.2 ModelBuilder to compute a neighborhood average for the diversity indices and the percentage of gay households at each census tract. The geoprocessing model used an iteration approach combined with a spatial query and statistical method. All census tracts in the study area were iterated over, and a spatial query was performed using spatial touching logic (Clementini, Di Felice, & van Oosterom, 1993). For each census tract, all adjacent tracks including those touching only at the corner (i.e., “Queens case” contiguity; Cliff, 1968) were selected and an average for each of the variables was calculated. The model then repeated the procedure with a new tract to reintegrate the spatial query. The spatial averages were added to the list of attributes for each tract as the model progressed. These newly computed ‘neighborhood’ values were used in a separate set of OLS and GWR regression models. For the smaller and more densely populated urban census tracts in particular this measure may provide a more accurate representation of neighborhood diversity. Additionally, if diversity as measured across neighboring census tracts is a more robust predictor of creative class residency than diversity at each individual census tract, this may suggest that the creative class merely wants to live near diversity, or within a diverse city district, even if their own immediate vicinity is less heterogenous. Such a finding would support Florida’s (2012, p. 294) expectation that “A person’s circle of closest friends may not
resemble the Rainbow Coalition — in fact it usually doesn’t — but creatives want the rainbow to be available."

Because a number of factors in addition to neighborhood diversity are expected to influence the intra-urban residential patterns of creative class workers, a set of control variables was identified by reviewing the literature (e.g., Frenkel et al. 2013; Lawton et al. 2013; Mansury et al. 2012; Yigitcanlar, Baum, & Horton, 2007) and performing visual analyses of potential variables using choropleth maps similar to those in Figs. 2 and 3. The seven control variables identified in this way included land value (as approximated using median home values), proximity to ‘top’ grade schools and colleges/universities, presence of water and open

Fig. 2. Dependent variables included the proportion of all workers in each census tract engaged in (A) creative class occupations, (B) super creative core occupations, and three specific super creative core occupational groups: (C) computer, engineering, and science; (D) education, library, and training; and (E) arts, design, and entertainment.
space, proximity to rail stations and 'third places', and population density. 'Top' grade schools included 122 elementary, middle, and high schools within the Chicago study area. Schools were ranked by the Chicago Sun Times (Rust & Golab, 2013) using standardized Illinois state achievement exam scores. Distance from the center of each census tract to the closest 'top' school was used to estimate proximity. The same methodology was used to calculate proximity to colleges/universities and rail stations. Colleges and universities included all non-profit institutions of higher learning within the Chicago study area, totaling 160 separate campuses. Both Metra (Chicago's commuter rail network) and 'L' (rapid transit) stations were used in the calculation of rail station proximity. Using the Multi-Resolution Land Characteristics Consortium's 2011 National Land Cover Database (Jin et al. 2013), the amount of land use classified as open space or water within a 2 km radius of each census tract centroid approximated the availability of recreational

Fig. 3. Independent variables included four measures of neighborhood diversity at the census tract scale: (A) percentage of gay households, (B) racial diversity, (C) linguistic diversity, and (D) income diversity. The diversity indices indicate the probability that two individuals chosen at random within a given census tract belong to different classes based on race/language/income.
and scenic amenities. Lastly, proximity to ‘third places’, was calculated by averaging the distance from each census tract centroid to the five nearest establishments. ‘Third places’ are typically consumption spaces separate from home (the ‘first place’) and work (the ‘second place’) that facilitate casual social interactions (Oldenburg, 1999). For the purposes of this study, ‘third places’ included coffee shops, bars, pubs, lounges, bookstores, and deli-bakeries. The location and attributes of ‘third places’ were identified using the ReferenceUSA® online database.

2.3. OLS regression modeling

Ordinary least squares (OLS) regression was used to assess the global associations between measures of diversity and the presence of creative class workers by census tract, and to identify well-specified models for use in the GWR analysis. Prior to modeling, a number of control variables were transformed using either their natural log or square root to improve linearity. A correlation analysis was also performed to provide an initial assessment of the relationships between variables and to identify potential redundancies. Each regression model contained one diversity variable and one to five control variables. Each diversity variable was run within a separate regression model so that the relationships between one type of diversity and the creative class was not affected by the variation in other types of diversity. Models were constructed using the stepwise procedure. Control variables were eliminated initially for non-significance; however, to minimize the potential for collinearity, significant control variables with the lowest predictive power were also eliminated such that each final model had an acceptably low condition index (CI) of 30 or less.

2.4. GWR modeling

In contrast to global regression models like OLS, which produce a single equation describing the relationships between independent and dependent variables, GWR generates separate equations for each individual observation. GWR may therefore be used to explore local variations in the relationships between variables (i.e., spatial nonstationarity). The GWR equation may be expressed as:

$$\hat{y}_i = \beta_0(u_i, v_i) + \sum_k \beta_k(u_i, v_i)x_{ik} + e_i$$  \hspace{1cm} (2)

where $y_i$ is the estimated value of the dependent variable at point $i$, $\beta_0$ is the intercept, $\beta_k$ is the parameter estimate for the independent variable $k$, $x_{ik}$ is the value of the $k$th variable for point $i$, and $(u_i, v_i)$ represents the coordinates of point $i$ (Fotheringham et al. 2002; Mennis, 2006).

We used the GWR 4.0 software package to examine the relationships between each diversity and creative class variable at each census tract, and to assess the degree of nonstationarity across the Chicago study area. It was necessary to specify a number of parameters and options prior to running each model. First, Gaussian was chosen as the most appropriate model type given the continuous nature of both the dependent and independent variables. Because the size of the census tracts varied from the center of the city outward, it was necessary to use an adaptive (bi-square) kernel as the weighting function to allow flexibility in the size of the bandwidth, or the distance over which neighboring census tracts are included in each local regression model. The Golden Section search technique (Greig, 1980) and the cross validation (CV) selection method (Brunsdon, Fotheringham, & Charlton, 1996) were used to identify the optimal bandwidth size at each location. Though the output of the GWR analysis produced at each census tract local $r^2$ values, variable coefficients, and pseudo $t$-values, for the sake of clarity and brevity, we chose to map and describe only the statistically significant pseudo $t$-values at the 95 and 99 percent confidence levels.

3. Results

3.1. General patterns

A series of choropleth maps were created in order to visualize patterns in creative class employment and diversity across the Chicago study area (Figs. 2 and 3). Similar to the spatial patterns observed by Florida (2013) of the creative class in New York, Boston, and San Francisco, creative class workers overall were found to reside in highest concentration within the urban core and outward along select suburban corridors reminiscent of Hoyt’s (1939) sector model. The inner suburbs of Chicago, by contrast, were home to relatively few creative class workers. They were found in particularly high concentrations along two major corridors: one extending from Chicago’s urban core (i.e., ‘the Loop’) north and northwest between Lake Michigan and I-90, and one extending west and southwest from Oak Park along I-88 to Naperville (Fig. 2a). The distribution of the super creative core exhibited a similar pattern (Fig. 2b). Lower-income African American and Hispanic communities immediately west and southwest of the downtown core exhibited the lowest proportion of creative class workers, including those in specific super creative core occupations (Fig. 2c–e). Workers employed in CES occupations exhibited a clustering pattern similar to creative class workers in general (Fig. 2c), while workers with ELT occupations were more evenly distributed across the study area (with the notable exception of communities near major universities exhibiting higher than average concentrations) (Fig. 2d), and ADE workers demonstrating a modest affinity for the urban core and areas north along Lake Michigan. Artists in particular may gravitate toward central urban neighborhoods to gain access to studio space and live/work units, training institutions, and a variety of social and entertainment amenities (Lloyd, 2002; Markusen, 2006).

The proportion of gay households and income diversity exhibited relatively little clustering across the study area, while racial and linguistic diversity displayed stronger and somewhat similar clustering patterns (Fig. 3). Although in general there exists no clear pattern of increasing or decreasing diversity from the center of the city outward, linguistic diversity was particularly low among the outer-most exurban/rural census tracts. This reflects the tendency of immigrant communities to cluster in central cities and well as particular suburban corridors that offer strong social support (Logan, Zhang, & Alba, 2002). Overall, the spatial associations between measures of diversity and creative class employment appear to be relatively weak. The racial/ethnic enclave to the west and south of the Loop, however, exhibited comparatively low levels of diversity and creative class employment. The Loop itself, on the other hand, exhibited both high levels of diversity and creative class employment. The strength and direction of the associations between diversity and creative class employment were more thoroughly examined using OLS regression and GWR.

3.2. OLS regression modeling

A preliminary correlation analysis revealed significant ($p < 0.05$) relationships between most diversity and creative class variables (Table 1). The proportion of workers with super creative core occupations, however, were not significantly correlated with either racial or linguistic diversity, and ADE occupations were not significantly correlated with racial diversity. All correlations between measures of diversity were positive and significant, particularly
Table 1 presents the results of the OLS regression analysis. Note that four model adjusted $r^2$ values are presented: the first corresponds to the model with a single diversity variable and select control variables as displayed in the tables; the second contains the same compliment of control variables, but no diversity variable (to facilitate a quick assessment of each diversity variable’s contribution to the model’s overall predictive power); the third replaces the diversity measure at each census tract with the equivalent neighborhood diversity measure; and the fourth corresponds to the associated GWR model. All models were significant at $p < 0.05$, however the predictive capability of the initial set of OLS regression models varied widely, with independent variables together explaining 10 to 63 percent of the variability in the dependent variable. The predictive capability was lower for models in which the super creative core and the three specific creative core occupational groups (CES, ELT, ADE) were dependent variables, suggesting that important explanatory variables for these more precise occupational classes remain unaccounted for.

Over the entire study area, census tracts with a higher proportion of gay households and income diversity were statistically more likely to have higher concentrations of creative class workers, including those in super creative core and associated occupations (Table 2). Census tracts with higher levels of linguistic diversity, however, tended to have lower proportions of creative class workers overall, with the exception of CES occupations. Racially diverse census tracts also exhibited a significantly lower proportion of creative class workers overall, but a higher proportion of workers within the super creative core, particularly those with CES occupations. These results support the hypothesis that spatial associations between neighborhood diversity and the creative class vary by type of diversity as well as specific occupational grouping.

Despite the significance of some of the diversity variables in the OLS regression models, their contributions to the overall predictive capability of the models proved limited. This may be observed by comparing the model adjusted $r^2$ with and without each diversity variable. The addition of the percent gay households variable, for example, raised the model adjusted $r^2$ from 0.627 to 0.630, explaining a mere 0.3 percent of the variability in the proportion of workers with creative class occupations (total) across census tracts. Measures of diversity with the highest explanatory power included percentage of gay households, which explained 6.5 percent of the variability in the proportion of workers with CES occupations, and linguistic diversity, which explained 3.2 percent of the variability in the proportion of workers with ELT occupations. Thus, if neighborhood diversity factors into the residential decisions of creative class workers, it appears to play a relatively minor role.

The predictive power of the OLS regression models generally remained similar when the standard diversity variables (calculated at each census tract) were replaced with ‘neighborhood’ diversity...
variables (calculated as the average diversity of all adjacent census tracts). The most substantial gain in predictive power, indicated by an increase in \( r^2 \) from 0.263 to 0.305, was observed when regressing the proportion of workers employed in ADE occupations against percent gay households at the ‘neighborhood’ level (Table 3). These data do not support the notion that the diversity of adjacent neighborhoods is a better predictor of the creative class than the diversity of the neighborhoods in which they reside. This analysis, however, may be expanded upon in future research by successively increasing the number of adjacent census tracts to represent larger neighborhood agglomerations and city districts.

Among the control variables, median household income was the most consistently significant predictor, accounting from 19 to nearly 65 percent of the variability in creative class workers. With the creative class positively associated with educational attainment and income (Florida et al. 2008), it is not unexpected that members of the creative class tend to reside in wealthier neighborhoods. Median home value, however, was a markedly stronger predictor of the creative class in general than the creative core or the three creative core occupational groups. This may be due to the relatively high-income ‘creative professionals’ (e.g., law, medicine), which are represented under the creative class but not the creative core. Proximity to top grade schools and colleges, and the availability of open space, were also significant predictors of creative class residence across multiple regression models. Schools and colleges provide educational and work opportunities for creative workers, while open space may contribute both recreational and scenic amenities. The propensity of the creative class for open space and top schools was similarly observed in Thailand (Mansury et al. 2012). Proximity to rail, however, was a significant predictor of workers with CES occupations only, while proximity to ‘third places’ was uniquely associated with ADE occupations. Though we speculate that this latter affiliation may reflect a tendency among those with ADE occupations to perform creative work outside the office, as well as reside in central urban neighborhoods that tend to have a higher density of ‘third places’ (Durmaz, 2015; Lloyd, 2002), more research is needed to explore these connections in detail.

3.3. GWR modeling

The predictive power of all models increased substantially when using GWR compared with OLS, indicating the potential for strong

Table 2

<table>
<thead>
<tr>
<th>Dependent variables</th>
<th>% Creative class</th>
<th>% Creative core</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sqrt(Med. home value)</td>
<td>0.631**</td>
<td>0.636***</td>
</tr>
<tr>
<td>Sqrt(Prox. top schools)</td>
<td>-0.147*</td>
<td>-0.134**</td>
</tr>
<tr>
<td>Sqrt(Prox. college)</td>
<td>-0.300**</td>
<td>-0.142**</td>
</tr>
<tr>
<td>Sqrt(Open SPACE)</td>
<td>0.257**</td>
<td>0.269**</td>
</tr>
<tr>
<td>Ln(Prox. rail)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ln(Prox. third places)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ln(Pop. density)</td>
<td>-0.086**</td>
<td>-0.055**</td>
</tr>
<tr>
<td>% Gay household</td>
<td>0.082**</td>
<td>-</td>
</tr>
<tr>
<td>Racial diversity</td>
<td>-</td>
<td>-0.047**</td>
</tr>
<tr>
<td>Lang. Diversity</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Income diversity</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Model Adj. ( r^2 )</td>
<td>0.627</td>
<td>0.624</td>
</tr>
<tr>
<td>a Model (no div.) Adj. ( r^2 )</td>
<td>0.621</td>
<td>0.621</td>
</tr>
<tr>
<td>b Model (neighbor) Adj. ( r^2 )</td>
<td>0.630</td>
<td>0.625</td>
</tr>
<tr>
<td>GWR model Adj. ( r^2 )</td>
<td>0.794</td>
<td>0.809</td>
</tr>
</tbody>
</table>

\( p < 0.05, ^* p < 0.01. \)

\( ^a \) \( r^2 \) value of the model without the diversity variable.

\( ^b \) \( r^2 \) value of the model with the diversity variable calculated as an average of all adjacent census tracts.

Table 3

<table>
<thead>
<tr>
<th>% Computer, engineering, science</th>
<th>% Education, library, training</th>
<th>% Art, design, entertainment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sqrt(Med. home value)</td>
<td>0.264**</td>
<td>0.276**</td>
</tr>
<tr>
<td>Sqrt(Prox. top schools)</td>
<td>-0.240**</td>
<td>-0.252**</td>
</tr>
<tr>
<td>Sqrt(Prox. college)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sqrt(Open space)</td>
<td>0.295**</td>
<td>0.308**</td>
</tr>
<tr>
<td>Ln(Prox. rail)</td>
<td>0.089**</td>
<td>0.087**</td>
</tr>
<tr>
<td>Ln(Prox. third places)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ln(Pop. density)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>% Gay household</td>
<td>0.068**</td>
<td>-</td>
</tr>
<tr>
<td>Racial diversity</td>
<td>-</td>
<td>0.151**</td>
</tr>
<tr>
<td>Lang. diversity</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Income diversity</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Model Adj. ( r^2 )</td>
<td>0.271</td>
<td>0.289</td>
</tr>
<tr>
<td>a Model (no div.) Adj. ( r^2 )</td>
<td>0.267</td>
<td>0.267</td>
</tr>
<tr>
<td>b Model (neighbor) Adj. ( r^2 )</td>
<td>0.283</td>
<td>0.285</td>
</tr>
<tr>
<td>GWR model Adj. ( r^2 )</td>
<td>0.466</td>
<td>0.486</td>
</tr>
</tbody>
</table>

\( p < 0.05, ^* p < 0.01. \)

\( ^a \) \( r^2 \) value of the model without the diversity variable.

\( ^b \) \( r^2 \) value of the model with the diversity variable calculated as an average of all adjacent census tracts.
spatial nonstationarity among the relationships between variables (Tables 2 and 3). For concision, we limit our analysis to the spatial variability in the relationships between creative class employment and measures of diversity. The results of the GWR analysis are organized by dependent variable (i.e., creative class measure) in Figs. 4–7. Note that both the significance of the relationships between variables (determined using pseudo t-values associated with the parameter estimates) and the direction of those relationships are indicated in the figures.

Starting with percent of workers with creative class occupations as the dependent variable (Fig. 4), percent gay households was positively significant in the vicinity of Aurora and Naperville in the western suburbs, the Chicago Heights/Homewood area in the southern suburbs, and smaller pockets within central Chicago, most notably South Loop, Logan Square, and Cicero/Berwyn. Percent gay households was negatively significant across a more limited area, running north from O'Hare International Airport along I-294 and east of I-94 between Highland Park and Waukegan. Positively significant associations between percent creative class (total) and both racial and linguistic diversity were also observed primarily in central Chicago, from South Loop southward through Bronzeville to Jackson Park, and on the west side in the vicinity of Oak Park. While gentrification may help explain man of the observed positive associations, Oak Park is somewhat anomalous in that it has managed to sustain a high level of racial/ethnic diversity for decades, primarily by regulating the racial composition of multi-unit housing (McKenzie & Ruby, 2002). Linguistic diversity was also positively significant in University Village/Little Italy (adjacent to the University of Illinois at Chicago), while racial diversity was positively significant in the Chicago Heights/Homewood area. Across much of the study area, however, racial and linguistic diversity exhibited either a non-significant or significant negative association with percent creative class (total). The variables exhibited a negative relationship in several, often overlapping, locations that generally included 1) north of the Loop along the lake shore, particularly around Evanston (home of Northwestern University) and Highland Park, 2) north of O'Hare, including the northwestern suburbs of Mt. Prospect, Arlington Heights, and Lake Zurich west to Crystal Lake, 3) the western suburbs of Villa Park west through Wheaton and St. Charles, and 4) the southwestern suburbs of Orland Park and Joliet. Finally, income diversity was positively significant in numerous communities inside the I-294 loop, as well as the southern suburbs of Chicago Heights/Homewood similar to percent gay households and racial diversity.

Overall, similar patterns were observed for percent of workers with super creative core occupations as the dependent variable, with a few notable exceptions (Fig. 5). The spatial nonstationarity of the relationships between percent gay households and percent super creative core was more pronounced, with much of the study area exhibiting either a significant positive or significant negative association between the two variables. New areas of significant positive association included the north shore between Evanston and Highland Park and the far northwestern suburbs. Much of the northern and southwestern suburbs, however, exhibited a significant negative association. While significant associations between the super creative core and both racial and linguistic diversity were still mostly negative, significant positive associations were slightly more pronounced within the urban core, particularly among neighborhoods directly south of the Loop (e.g., Near South Side, Bronzeville, Hyde Park, Woodlawn). There was also a modest reduction in the number of census tracts exhibiting significant positive associations between income diversity and the super creative core when compared to the creative class (total) (Fig. 4).

In reporting the results of the GWR analysis for the three specific super creative core occupational groups (Figs. 6–8), we highlight here the more substantial deviations from those patterns of spatial nonstationarity already discussed for the creative class (total) and super creative core. Firstly, fewer negative associations were observed between racial diversity and the proportion of workers with both CES (Fig. 6) and ADE (Fig. 8) occupations. Also, for the first time, racial diversity was positively related to a measure of the creative class (i.e., the proportion of CES workers) in the western suburbs, including parts of Naperville, Warrenville, and Aurora. The relationships between both percent CES and ELT workers and linguistic diversity exhibited a particularly pronounced spatial dichotomy, with significant positive associations limited almost entirely to the neighborhoods directly south of the Loop (Figs. 6 and 7). Throughout much of the study area there were no significant associations between income diversity and the proportion of ADE workers (Fig. 8). The two clusters exhibiting significant positive associations were also present for super creative core occupations in general: the Uptown/Edgewater neighborhoods along the north shore, and the South Loop extending into Bronzeville.

A separate and final GWR procedure was performed to highlight spatial variations in the relationship between percent gay households as calculated using a neighborhood mean and the proportion of ADE workers (Fig. 9). This particular analysis was performed because the OLS regression analysis indicated the possible boost in model predictive power when substituting percent gay households calculated at each census tract for a neighborhood mean (i.e., the mean percent gay households for all adjacent census tracts). The number of census tracts exhibiting significant positive associations between ADE workers and percent gay households expanded substantially, particularly in the Oak Park/Elmwood Park neighborhoods west of the Loop and from Evanston to Highland Park north of the Loop (Fig. 9). A neighborhood statistic may be a more appropriate means of assessing diversity in sexual orientation due to the high degree of variation between census tracts and the overall scarce nature of homosexual households, with few or none reported in many census tracts (Fig. 3). The more extensive positive spatial associations between percent gay households and ADE workers using a neighborhood statistic may also indicate that these artistically-inclined, or bohemian, workers prefer to embed themselves within relatively diverse central-city districts, even if their own street or smaller neighborhood unit is more homogenous.

4. Discussion & conclusions

To the authors' knowledge, this study represents the first attempt to test empirically whether a significant association between the creative class and diversity exists at the neighborhood level. The OLS regression analysis identified several statistically significant relationships between the two sets of variables when controlling for select urban attributes and amenities. The strength and direction of the association varied both by creative class grouping and type of diversity, but in general the proportion of workers employed in creative class occupations exhibited a significant and positive association with percent of gay households and income diversity, but either a non-significant or significant negative association with racial and linguistic diversity. The results therefore only partially support Florida's creative class theory, most notably in regard to the spatial association between gays and the creative class (2002; 2012). As mentioned previously, Florida claims that the presence of a visible gay community is one of the strongest signals that a place is tolerant and welcoming to outsiders; characteristics of place expected to be of value to members of the creative class. Similarly, the significant positive associations between income diversity and the creative class support the notion that creative class workers prefer neighborhoods that offer economic variety, while at the same time favoring wealthier communities.
(mainly in the urban core and outer suburbs) with higher median home values.

The professed desire for tolerance, however, does not appear to extend as uniformly to racial and ethnic diversity. Florida (2012, p. 59) has acknowledged that “African Americans are underrepresented in Creative Class occupations and make nearly $10,000 less than their white peers, even when controlling for education, skill, and work effort ….” Florida (2002) also found a negative association

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**Fig. 4.** Results of the GWR analyses with percent of workers with creative class occupations as the dependent variable.
between racial diversity and high-tech industry at the metropolitan level. As Florida (2012, p. 58) admits, ‘creatives’ do appear to limit their preference for social variety to “a diversity of elites, with membership limited to highly educated, creative people.” Florida’s ‘diversity of elites’ would surely extend to well-educated and highly skilled immigrants, but not to the majority of non-native speakers who hold low-skill service occupations. Due to economic constraints and strong social ties, immigrants with

Fig. 5. Results of the GWR analyses with percent of workers with super creative core occupations as the dependent variable.
poor English skills often concentrate in relatively homogenous immigrant enclaves with limited socio-economic and ethnic diversity (Betancur, 2011; Logan, Alba, & Stults, 2003; Pamuk, 2004). Areas of Chicago’s urban core identified as gentrification ‘hot spots’, including Bronzeville/Hyde Park, Oak Park, University Village/Little Italy, Pilsen, and the Near West Side/West Town, were generally those identified in the GWR analysis as having significant positive associations between racial/linguistic diversity and creative class
workers. These areas have seen an influx of artists, white professionals, and an expanding Latino middle-class in recent years, often contributing to substantial and contested neighborhood change (Betancur, 2011; Boyd, 2000; Sternberg & Anderson, 2014).

There has generally been less racial or ethnic turnover in Bronzeville, a historically black community south of the Loop; however the area is in a state of socio-economic transition as it becomes increasingly attractive to middle class blacks (Boyd, 2000; Wilson &

Fig. 7. Results of the GWR analyses with percent of workers with education, library, and training occupations as the dependent variable.
Whether such gentrification promotes or inhibits social mixing remains a matter of academic debate (Lees, 2008). Although the associations between the diversity and creative class variables were often statistically significant, it is important to consider that in most global models the diversity variables added little to the overall predictive power. While on the surface this suggests that diversity plays a minor role in determining within which neighborhoods creative class workers reside, the GWR

Fig. 8. Results of the GWR analyses with percent of workers with arts, design, and entertainment occupations as the dependent variable.
analysis demonstrated that spatial nonstationarity may have resulted in significant positive and significant negative relationships across the study area effectively ‘canceling out’ in some cases, thus resulting in otherwise robust predictive variables having minimal impact. For example, the proportion of workers with super creative core occupations was significantly associated, about equally positive and negative, with the proportion of gay households across much of the study area, revealing strong but often opposing spatial associations between the two variables.

Most OLS regression and GWR models exhibited minimal sensitivity to changes in spatial extent; the associations between creative class and diversity variables were generally similar when analyzed using individual census tracts and neighborhood (i.e., all adjacent tracts) averages. The relationship between percent gay households and the proportion of ADE workers, however, was noticeably enhanced when using neighborhood averages. This may reflect the tendency of both gays and artists/bohemians, as historically marginalized groups, to seek out city districts perceived as open and tolerant (Brown & Meczynski, 2009; Florida & Mellander, 2009; Hayslett & Kane, 2011). As a classic example of the Modifiable Areal Unit Problem (MAUP), this exception highlights the need to consider different spatial units in quantitative analyses, particularly when working with pre-aggregated census data and a spatial concept as ‘fuzzy’ as neighborhood (Spielman & Logan, 2013). It

Fig. 9. Results of the GWR analyses with percent of workers with arts, design, and entertainment occupations as the dependent variable, and percentage of gay households averaged over all adjacent census tracts as the predictor variable.
also helps to underscore the broad utility of the GWR procedure, which not only facilitated a detailed exploration of spatial non-stationarity, but also demonstrated how these locally varying relationships may themselves vary by redefining the unit of analysis.

The spatial correlations observed between diversity and the creative class at the neighborhood level do not necessarily imply that the same relationships will exist at the city or metropolitan level. Although studies of creative class workers at the inter-urban scale have generally indicated that diversity is not a significant pull-factor in comparison with employment opportunities and social ties (Boren & Young, 2013; Brown & Meczynski, 2009; Marlet & Van Woerkens, 2005; Scott, 2010), Mustard and Gritsai (2013) concluded that ‘soft’ locational factors including openness and tolerance may be considered “icing on the cake,” with at least a limited capacity to attract and/or retain creative workers. However, having based their conclusions on survey responses and a limited set of interviews, the authors admit that their findings “have to be seen as hypotheses that require further empirical testing.” Indeed, the mechanisms by which tolerance and diversity may aid specifically in the retention of creative class workers have yet to be fully investigated. An exploration of the potential connections between specific types of diversity (e.g., racial/ethnic, socio-economic, demographic) and both the attraction and retention of creative class workers at the inter-urban scale may also enable a fruitful comparison with the neighborhood-level results presented in this study.

The significant, though often highly localized, relationships between neighborhood diversity and the proportion of creative class workers suggests some measure of correlation, though not necessarily causation. That is, we cannot conclude based on these findings that the presence of one inevitably leads to the presence or absence of the other. An investigation of diversity and the creative class that takes into account change in both parameters over a multi-year period could help identify where diversity might act as a pull-factor and where it may be enhanced by creative class immigration (i.e., ‘creative gentrification’). Additional work is also recommended to evaluate the extent to which creative capital (i.e., the proportion of workers with creative class occupations) may differ from human capital (i.e., educational attainment) in relation to intra-urban diversity. Though we anticipate few differences given the strong correlation observed between the two measures (Boschma & Fritsch 2009; Glaeser, 2005; Hansen, 2007), any substantial deviation would support the notion that what people study and what people actually do for a living anticipate different residential preferences for tolerance/diversity. Finally, the use of alternative classification schemes may also warrant investigation to determine how sensitive the relationships observed in this study are to changes in the operationalization of the creative class concept.

Are creative class workers more likely to live in diverse neighborhoods when controlling for select urban attributes and amenities? Our results indicate that 1) this is generally true for sexual orientation and income diversity, but much less so for racial and linguistic diversity, and 2) diversity appears to play a rather limited role overall in predicting where within Chicago creative class workers are likely to settle, though there exists considerable spatial variation in the strength of these relationships. This is perhaps not surprising given the range of values and preferences within the creative class itself, and the shifting needs and desires that accompany different life-cycle stages (Frenkel 2013b). Here we have shown that the propensity of creative class workers to live in diverse neighborhoods varies by occupational grouping (i.e., CES, ELT, and ADE occupations). Future research could shed light on the role of additional factors such as age, familial status, and behavioral patterns in the attitudes and locational decisions of creative class workers in relation to neighborhood diversity. ‘Classic’ locational factors (i.e., home values, top schools, proximity to transit & open space) were, in many regression models, much stronger predictors of the proportion of creative class workers, supporting the conclusion reached in previous studies (e.g., Frenkel et al., 2013a, 2013b; Lawton et al. 2013; Mansury et al. 2012) that ‘soft’, ‘quality of place’ amenities, including social diversity, are at best secondary factors in the intra-urban location decision of creative class and knowledge workers. Just as crucially, the spatial relationships between diversity and the creative class observed in this case study were often negative, suggesting that polarization along racial and ethnic lines remains quite stubborn, even as many inner city neighborhoods undergo rapid socio-economic change. If the goal is to reduce spatial inequality and segregation, then the results of this study suggest that municipal (and regional where applicable) governments will need to be more pro-active in stimulating diversity while at the same time ensuring access to affordable housing. A closer examination of those neighborhoods that have managed to foster and maintain both diversity and creative capital over time may provide instructive clues as to how a more productive, equitable, and sustainable balance may be realized.

References
transit (LRT) system on residential property values using geographically weighted regression (GWR). Applied Spatial Analysis, 8(1), 1–25.


