AN ABSTRACT OF THE DISSERTATION OF

Candice Michelle Weems for the degree of Doctor of Philosophy in Geography presented on March 18, 2016.


Abstract approved:

______________________________________________________
Julia A. Jones

This dissertation examines the spatial distribution of park access by type in relation to trajectories of gentrification in Seattle from 1990 to 2010. The dissertation includes 5 Chapters. The first chapter provides an overview of the literature that motivated this research. The second, third and fourth chapters are research papers that seek to address the overall question: What is the relationship between park access and trajectories of gentrification? Chapter 5 is an overall conclusion. This study tests how the urban parks shape the communities around them and focuses on three main objectives: (1) To gain a better understanding of socioeconomic and racial factors that are associated with gentrification in Seattle, Washington, (2) To develop a transferrable approach for assessing trajectories of gentrification in urban areas, and (3) To determine how the spatial distribution of different park types and community investment in parks are associated with gentrification. The research is motivated by the environmental justice literature and seeks to explore issues as they affect where people live and how they interact with parks in a large urban area. Little is known about how environmental amenities such as parks interact with socio-economic and racial characteristics of neighborhoods over time. Chapter 2, examined the relationships among park system development over time, park typologies, and socio-
economic and racial patterns, in order to understand how park system evolution is related to environmental justice. The results suggest that park access differed among socio-economic groups, and by park type. Significantly greater proportions of African Americans and Asians were found in census block groups with below-median levels of education, income, and home value, which in turn had access to significantly larger numbers and more area of recreation parks. In contrast, census block groups with above-median income, home value and education, which had significantly fewer minorities, had access to greater numbers and more area of natural passive and multiuse natural parks. The patterns did not change much over the study period suggesting that park development had the effect of maintaining differences in park access. This work raises the question of whether investments in park improvements led or followed the changes in educational attainment, home value, and income, suggesting that further work is needed to test hypotheses of environmental gentrification in Seattle. Chapter 3, used available digital spatial data including census data as well as spatially explicit mixed media coverage to map gentrification in order to test hypotheses about causes and consequences of the process.

Gentrification was defined as change from below to above the median value for education, income, and home value in a census block group over the period 1990 to 2000 or 2000 to 2010. These patterns were compared to changes in proportions of minorities and perceptions of gentrification in the media over those time periods. Gentrification was clustered in central, north and west Seattle. In Central Seattle these changes were accompanied by large declines in the proportion of African Americans in the population. However, gentrification in terms of education, income, and home value also occurred in areas that did not have large proportions of minorities. Media perceptions of gentrification were reported in places that met the definition of gentrification, but also in areas experiencing changes in minorities, but which did not yet meet the definition of change in terms of education, home value, and income. The findings of this study suggest that gentrification is multifaceted, multidimensional and spatially contagious process that does not always lead to displacement of minorities. More work is needed to understand the causes of gentrification especially with regard to the role of urban parks. Chapter 4 examined
the relationships between spatial patterns of change and investment in urban parks and processes of gentrification overtime. A spatial analysis was conducted using GIS to test relationships between changes in socioeconomic characteristics and changes in parks from 1990 to 2010. Changes in access to three different park types (recreation, natural passive, and multiuse natural) were compared to changes in socioeconomic characteristics from 1990 to 2000 and 2000 to 2010. Spatial data on community-initiated investment in parks were also compared to spatial patterns of change in park access and socioeconomic characteristics. The results suggest that gentrification was associated with locations where the number and acreage of recreational and natural passive parks increased from 1990 to 2000, and where high levels of park investment had occurred from 2000 to 2010. Therefore, changes in park access and investment influence the character of neighborhoods over time. The results also showed that moderate and low values of park investment were less associated with gentrification. The findings ultimately contribute to the understanding of resilience of a community and the capacity to absorb changes without being pushed into a gentrified regime. Lastly, Chapter 5 provides an overall conclusion to this dissertation and provides suggestions for future research.

Keywords: GIS, park access, gentrification, environmental gentrification, community investment
Examinining the Spatial distribution of Park Access and Trajectories of Gentrification in Seattle, Washington 1990 - 2010

by
Candice Michelle Weems

A DISSERTATION

submitted to
Oregon State University

in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

Presented March 18, 2016
Commencement June 2016
Doctor of Philosophy dissertation of Candice Michelle Weems presented on March 18, 2016

APPROVED:

Major Professor, representing Geography

Dean of the College of Earth, Ocean, and Atmospheric Sciences

Dean of the Graduate School

I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

Candice Michelle Weems, Author
ACKNOWLEDGEMENTS

This has been a wonderful journey. I am thankful to God who has brought this far and will continue to take me places. Thank you to all that have contributed their time and effort to help me become the scholar that I am.

I would like to take this time thank key players in this dissertation and my life. Firstly, I would like to thank my advisor, Dr. Julia A. Jones. She has never doubted my abilities. She took me under her wing back in 2010 and has taught me so much, cared for me and my family and has gone above and beyond the call of an advisor. She is top notch and I am ever grateful for her kindness, generosity and guidance. Next I would like to thank my committee members, Dr. Mary Santelmann, Dr. Lori Cramer, Dr. Jenna Tilt, and Dr. Christine Olsen (GCR). My committee members have encouraged me and taught me so much over the years. I appreciate their willingness to sit with me and guide and challenge me through my dissertation and provide me with thoughtful insight.

My family has played a key role in my journey throughout life and graduate school. To my mother, Hannah Weems, father, Melvin Weems, brothers (Mark and Michael) and sister (Melanie), THANK YOU! You have encouraged me from day one. My family has been the key to my success and I am grateful for their support and never failing love. To my husband, Daniel Landry, thank you for taking this journey with me. I appreciate your support and continued love and encouragement. I am also thankful for my daughter, Hannah who has filled my heart with joy and laughter. She is the apple of my eye.

Lastly, I would like to thank my extended family: my friends (Jen Vielleux, Alison Doniger, Julie Watson, Julie Klah, Kim Ogren, Lucy Romeo, Jacob Petersen Perlman, Laura Hardin, Melva Trevino-Peña, Katherine Jones, Melissa McCracken, Dori Dick - and a host of other friends). I love and care for you all. Together through the years we have done it all! We will forever remain friends through the thick and thin. And to my best friend, Shiloh Sundstrom, I love you and will forever miss you.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chapter 1</strong> Introduction</td>
<td>1</td>
</tr>
<tr>
<td>1. Conceptual Framework</td>
<td>2</td>
</tr>
<tr>
<td>2. Environmental Justice</td>
<td>4</td>
</tr>
<tr>
<td>3. Trajectories of Gentrification</td>
<td>9</td>
</tr>
<tr>
<td>3.1 Cultural theories of Gentrification</td>
<td>9</td>
</tr>
<tr>
<td>3.2 Economic theories of Gentrification</td>
<td>10</td>
</tr>
<tr>
<td>3.3 Environmental Gentrification</td>
<td>11</td>
</tr>
<tr>
<td>4. Park Planning in Seattle</td>
<td>12</td>
</tr>
<tr>
<td>5. Park Typology</td>
<td>14</td>
</tr>
<tr>
<td>6. Conclusion</td>
<td>14</td>
</tr>
<tr>
<td>7. References</td>
<td>15</td>
</tr>
</tbody>
</table>

**Chapter 2** Access to parks in Seattle: relationship of park type to socioeconomic variables, 1990 – 2010 | 20 |

1 Introduction and Research Questions | 22 |
1.1 Park typologies | 22 |
1.2 Evolution of park systems over time – the role of the government | 24 |
1.3 Park access and environmental justice | 24 |
1.4. Research questions: Park system evolution, park types, and environmental justice | 25 |
1.5 Research hypotheses | 26 |
2 Study Site | 28 |
3. Data Sources and Methods | 31 |
TABLE OF CONTENTS (Continued)

3.1 Socioeconomic data sources ......................................................... 31
3.2 Park data sources........................................................................... 33
3.3 Defining above-and-below median census block groups............... 34
3.4 Park types, distribution and access................................................. 34
3.5 Statistical Analysis........................................................................ 36

4 Results ............................................................................................ 36
4.1 Park distribution by type and changes in spatial distribution of parks over time ................................................................. 36
4.2 Locations of above and below median census block groups......... 38
4.3 Relationships among park area, park type, home value income, and education ................................................................. 43
4.4 Access to Recreation Parks and change over time by education, home value and income ................................................................. 44
4.5 Access to Natural Passive Parks and change over time by education, home value and income ................................................................. 45
4.6 Access to Multiuse Parks and change over time by education, home value and income ................................................................. 47
4.7 Trends in park access over time by socioeconomic group......................... ................................................................. 49
4.8 Relationship of park access to race .................................................. 50

5 Discussion .......................................................................................... 52
5.1 Park access and socioeconomic variables in Seattle ....................... 52
5.2 Methodological issues..................................................................... 52
5.3 Changes in park distribution over time – the role of park investment....................................................................................... 53
TABLE OF CONTENTS (Continued)

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.4 Disparities in park access and environmental justice</td>
<td>55</td>
</tr>
<tr>
<td>5.5 Changes in park access and implications for gentrification</td>
<td>56</td>
</tr>
<tr>
<td>5.6 Implications for park planning</td>
<td>56</td>
</tr>
<tr>
<td>6. Conclusion</td>
<td>57</td>
</tr>
<tr>
<td>7. References</td>
<td>59</td>
</tr>
<tr>
<td>8. Appendix</td>
<td>62</td>
</tr>
<tr>
<td>Chapter 3 Spatial patterns of gentrification in Seattle: multifaceted, dynamic interactions</td>
<td>65</td>
</tr>
<tr>
<td>1 Introduction and Research Questions</td>
<td>66</td>
</tr>
<tr>
<td>2 Study Site</td>
<td>68</td>
</tr>
<tr>
<td>3. Data Sources and Methods</td>
<td>68</td>
</tr>
<tr>
<td>3.1 Data sources</td>
<td>68</td>
</tr>
<tr>
<td>3.2 Spatial data analysis</td>
<td>70</td>
</tr>
<tr>
<td>3.3 Mapping gentrified census block groups</td>
<td>71</td>
</tr>
<tr>
<td>3.4 Change in African American populations</td>
<td>73</td>
</tr>
<tr>
<td>3.5 Content analysis on select neighborhoods of gentrified census block groups</td>
<td>73</td>
</tr>
<tr>
<td>4 Results</td>
<td>74</td>
</tr>
<tr>
<td>4.1 Changes in spatial patterns of education, home value and household income</td>
<td>74</td>
</tr>
<tr>
<td>Section</td>
<td>Page</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>4.2 Spatial patterns of socioeconomic change and gentrification, 1990 to 2000</td>
<td>81</td>
</tr>
<tr>
<td>4.3 Spatial patterns of socioeconomic change and gentrification, 2000 to 2010</td>
<td>84</td>
</tr>
<tr>
<td>4.4 Racial changes in gentrified census block groups, 1990 – 2000</td>
<td>86</td>
</tr>
<tr>
<td>4.5 Racial changes in gentrified census block groups, 2000 – 2010</td>
<td>89</td>
</tr>
<tr>
<td>4.6 Relationships of racial change to gentrification</td>
<td>95</td>
</tr>
<tr>
<td>4.7 Within neighborhood spatial and temporal patterns of gentrification and racial change</td>
<td>98</td>
</tr>
<tr>
<td>4.8 Content analysis on select neighborhoods of gentrified census block groups 1990 – 2010</td>
<td>100</td>
</tr>
<tr>
<td>4.8.1 Demographic shifts</td>
<td>101</td>
</tr>
<tr>
<td>4.8.2 Sense of Community (or lack thereof)</td>
<td>102</td>
</tr>
<tr>
<td>4.8.3 Economic and development booms</td>
<td>103</td>
</tr>
<tr>
<td>5 Discussion</td>
<td>103</td>
</tr>
<tr>
<td>5.1 Hypothesis 1</td>
<td>104</td>
</tr>
<tr>
<td>5.2 Hypothesis 2</td>
<td>105</td>
</tr>
<tr>
<td>5.3 Hypothesis 3</td>
<td>106</td>
</tr>
<tr>
<td>5.4 Hypothesis 4</td>
<td>107</td>
</tr>
<tr>
<td>5.5 Methodological issues</td>
<td>107</td>
</tr>
<tr>
<td>6. Conclusion</td>
<td>108</td>
</tr>
</tbody>
</table>
TABLE OF CONTENTS (Continued)

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Literature Cited</td>
<td>109</td>
</tr>
<tr>
<td>Chapter 4 Gentrification and changes in park access and investment in Seattle, 1990-2010</td>
<td>113</td>
</tr>
<tr>
<td>1 Introduction and Research Questions</td>
<td>114</td>
</tr>
<tr>
<td>2 Study Site</td>
<td>116</td>
</tr>
<tr>
<td>3. Data Sources and Methods</td>
<td>117</td>
</tr>
<tr>
<td>3.1 Socioeconomic data sources</td>
<td>117</td>
</tr>
<tr>
<td>3.2 Data on park investments</td>
<td>118</td>
</tr>
<tr>
<td>3.3 Determine changes in park access</td>
<td>120</td>
</tr>
<tr>
<td>3.4 Identify gentrified census block groups</td>
<td>120</td>
</tr>
<tr>
<td>3.5 Define environmental gentrification and how environmental gentrification will be tested</td>
<td>120</td>
</tr>
<tr>
<td>4 Results</td>
<td>120</td>
</tr>
<tr>
<td>4.1 Park investment vs. gentrification</td>
<td>120</td>
</tr>
<tr>
<td>4.2 Changes in park access and gentrification</td>
<td>124</td>
</tr>
<tr>
<td>4.2.1 Changes in park access and gentrification – recreation parks</td>
<td>124</td>
</tr>
<tr>
<td>4.2.2 Changes in park access and gentrification – natural passive parks</td>
<td>127</td>
</tr>
<tr>
<td>4.2.3 Changes in park access and gentrification – multiuse parks</td>
<td>129</td>
</tr>
<tr>
<td>4.3 Park investment, changes in park access and gentrification</td>
<td>132</td>
</tr>
<tr>
<td>Section</td>
<td>Page</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>4.3.1 Park investment, changes in park access and gentrification –</td>
<td>132</td>
</tr>
<tr>
<td>recreation parks</td>
<td></td>
</tr>
<tr>
<td>4.3.2 Park investment, changes in park access and gentrification –</td>
<td>135</td>
</tr>
<tr>
<td>natural passive parks</td>
<td></td>
</tr>
<tr>
<td>4.3.3 Park investment, changes in park access and gentrification –</td>
<td>137</td>
</tr>
<tr>
<td>multiuse parks</td>
<td></td>
</tr>
<tr>
<td>5. Discussion</td>
<td>140</td>
</tr>
<tr>
<td>6. Conclusion</td>
<td>142</td>
</tr>
<tr>
<td>7. Literature Cited</td>
<td>143</td>
</tr>
<tr>
<td>Chapter 5 Conclusion</td>
<td>145</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>The society and land use model</td>
<td>3</td>
</tr>
<tr>
<td>2.1</td>
<td>Census block groups in the city of Seattle</td>
<td>30</td>
</tr>
<tr>
<td>2.2</td>
<td>Directional Distribution of parky types added to park system 1990-201</td>
<td>38</td>
</tr>
<tr>
<td>2.3</td>
<td>The spatial distribution of census block groups with household income above or below the median household income in Seattle, 1990, 2000, and 2010</td>
<td>40</td>
</tr>
<tr>
<td>2.4</td>
<td>The spatial distribution of census block groups with home value above or below the median home value in Seattle, 1990, 2000, and 2010</td>
<td>41</td>
</tr>
<tr>
<td>2.5</td>
<td>The spatial distribution of census block groups with educational attainment above or below the median educational attainment in Seattle, 1990, 2000, and 2010</td>
<td>42</td>
</tr>
<tr>
<td>2.6</td>
<td>Difference in number of parks, above vs. below median household income</td>
<td>49</td>
</tr>
<tr>
<td>2.7</td>
<td>Difference in areas (natural log of acres) of parks, above vs. below-median household income</td>
<td>50</td>
</tr>
<tr>
<td>3.1</td>
<td>Example transition matrix</td>
<td>72</td>
</tr>
<tr>
<td>3.2</td>
<td>The spatial distribution of census block groups categorized as being greater than or less than or equal to the city of Seattle median for median household income from 1990 – 2010</td>
<td>77</td>
</tr>
<tr>
<td>3.3</td>
<td>The spatial distribution of census block groups categorized as being greater than or less than or equal to the city of Seattle median for median home value from 1990 – 2010</td>
<td>78</td>
</tr>
<tr>
<td>3.4</td>
<td>The spatial distribution of census block groups categorized as being greater than or less than or equal to the city of Seattle median for educational attainment from 1990 – 2010</td>
<td>79</td>
</tr>
<tr>
<td>Figure</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>3.5 The graphical representation of the transition matrix showing the locations of each census block group above or below the city median for each socioeconomic category from 1990 to 2010</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>3.6 The spatial distribution of socioeconomic change and gentrification in Seattle from 1990 – 2000</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>3.7 The spatial distribution of socioeconomic change and gentrification from 2000 to 2010</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>3.8 Change in the African American racial composition in the Central Area from 1990 to 2000</td>
<td>87</td>
<td></td>
</tr>
<tr>
<td>3.9 Change in the African American racial composition in the Rainier Valley from 1990 to 2000</td>
<td>88</td>
<td></td>
</tr>
<tr>
<td>3.10 Change in racial composition of the Asian racial group in the University District from 1990 to 2000</td>
<td>89</td>
<td></td>
</tr>
<tr>
<td>3.11 Change in the African American racial composition in gentrified census block groups in the Central Area from 2000 to 2010</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>3.12 Positive change in African American population in gentrified census block groups in various neighborhoods in Seattle from 2000 to 2010</td>
<td>92</td>
<td></td>
</tr>
<tr>
<td>3.13 Spatial distribution of the greatest negative change in Asian racial groups within gentrified census block groups from 2000 – 2010</td>
<td>93</td>
<td></td>
</tr>
<tr>
<td>3.14 Greatest positive change in Asian population in a gentrified census block group in the Downtown and Cascade neighborhoods from 2000 to 2010</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td>3.15 Percent African American in 1990</td>
<td>97</td>
<td></td>
</tr>
<tr>
<td>3.16 Gentrified and declining census block groups, change in percentage of African American residents within each census block group, and places where gentrification was perceived</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td>Figure</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>3.17 Expanded views of selected areas shown in Figure 16</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>4.1 Percent of census block groups in this category, in which there was some (nonzero) investment in parks from (a) 1990-2000 and (b) 2000-2010</td>
<td>122</td>
<td></td>
</tr>
<tr>
<td>4.2 Average size of park investment for census block groups which gentrified, did not change or declined from (a) 1990-2000 and (b) 2000-2010</td>
<td>123</td>
<td></td>
</tr>
<tr>
<td>4.3 1990-2010 Change in the number of recreation parks within 800m of census block groups in relation to gentrified and declined census block groups</td>
<td>125</td>
<td></td>
</tr>
<tr>
<td>4.4 1990-2010 Change in acreage of recreation parks within 800m of census block groups in relation to gentrified and declined census block groups</td>
<td>126</td>
<td></td>
</tr>
<tr>
<td>4.5 1990-2010 Change in the number of natural passive parks within 800m of census block groups in relation to gentrified and declined census block groups</td>
<td>128</td>
<td></td>
</tr>
<tr>
<td>4.6 1990-2010 Change in acreage of natural passive parks within 800m of census block groups in relation to gentrified and declined census block groups</td>
<td>129</td>
<td></td>
</tr>
<tr>
<td>4.7 1990-2010 Change in the number of multiuse parks within 800m of census block groups in relation to gentrified and declined census block groups</td>
<td>131</td>
<td></td>
</tr>
<tr>
<td>4.8 1990-2010 Change in acreage of multiuse parks within 800m of census block groups in relation to gentrified and declined census block groups</td>
<td>132</td>
<td></td>
</tr>
<tr>
<td>4.9 1990-2010 Recreation park investment compared to change in number of recreation parks within 800m of census block groups in relation to gentrified and declined census block groups</td>
<td>133</td>
<td></td>
</tr>
<tr>
<td>4.10 1990-2010 Recreation park investment compared to change in recreation park acreage within 800m of census block groups in relation to gentrified and declined census block groups</td>
<td>134</td>
<td></td>
</tr>
<tr>
<td>4.11 1990-2010 Natural passive park investment compared to change in natural passive park acreage within 800m of census block groups in relation to gentrified and declined census block groups</td>
<td>136</td>
<td></td>
</tr>
<tr>
<td>Figure</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>4.12 1990-2010 Natural passive park investment compared to change in number of natural passive parks within 800m of census block groups in relation to gentrified and declined census block groups</td>
<td>137</td>
<td></td>
</tr>
<tr>
<td>4.13 1990-2010 Multiuse park investment compared to change in multiuse park acreage within 800m of census block groups in relation to gentrified and declined census block groups</td>
<td>139</td>
<td></td>
</tr>
<tr>
<td>4.14 1990-2010 Multiuse park investment compared to change in number of multiuse parks within 800m of census block groups in relation to gentrified and declined census block groups</td>
<td>140</td>
<td></td>
</tr>
<tr>
<td>5.1 The modified Society and Land use model</td>
<td>145</td>
<td></td>
</tr>
</tbody>
</table>
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Seattle park classification</td>
<td>24</td>
</tr>
<tr>
<td>2.2 Socioeconomic variables</td>
<td>33</td>
</tr>
<tr>
<td>2.3 City of Seattle median by socioeconomic variable, 1990 – 2010</td>
<td>34</td>
</tr>
<tr>
<td>2.4 Numbers and area of parks by type in Seattle in 1990, 2000, 2010 and park acreage added by decade and park type</td>
<td>37</td>
</tr>
<tr>
<td>2.5 The percentage of census block groups categorized as greater than or less than the city of Seattle median for each socioeconomic characteristic by year</td>
<td>39</td>
</tr>
<tr>
<td>2.6 Mean number of recreation parks within 800m of census block groups above or below the Seattle median for each socioeconomic category 1990 – 2010</td>
<td>45</td>
</tr>
<tr>
<td>2.7 Group means for recreation park area within 800m of census block groups above or below Seattle median for each socioeconomic category 1990-2010</td>
<td>45</td>
</tr>
<tr>
<td>2.8 Mean number of natural passive parks within 800m of census block groups above or below the Seattle median for each socioeconomic category 1990 – 2010</td>
<td>46</td>
</tr>
<tr>
<td>2.9 Group means for natural passive park area within 800m of census block groups above or below Seattle median for each socioeconomic category 1990-2010</td>
<td>47</td>
</tr>
<tr>
<td>2.10 Mean number of multiuse parks within 800m of census block groups above or below the Seattle median for each socioeconomic category 1990 – 2010</td>
<td>48</td>
</tr>
<tr>
<td>2.11 Group means for multiuse park area within 800m of census block groups above or below Seattle median for each socioeconomic category 1990-2010</td>
<td>48</td>
</tr>
<tr>
<td>2.12 Mean percentage of African Americans in census block groups above or below the median for each socioeconomic variable, 1990 – 2010</td>
<td>51</td>
</tr>
<tr>
<td>Table</td>
<td>Page</td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>2.13 Mean percentage of Asians in census block groups above or below the median for each socioeconomic variable, 1990 – 2010</td>
<td>51</td>
</tr>
<tr>
<td>3.1 Socioeconomic variables collected by the US Census Bureau (Census Bureau, 1990, 2000, 2010). These variables were used to analyze the process of socioeconomic change from 1990 – 2010</td>
<td>70</td>
</tr>
<tr>
<td>3.2 City of Seattle overall median for selected socioeconomic characteristics for each decennial census year (1990, 2000, and 2010)</td>
<td>71</td>
</tr>
<tr>
<td>3.3 The transition trajectory for census block groups above or below the city median in for each census year</td>
<td>71</td>
</tr>
<tr>
<td>3.4 The percentage of census block groups categorized as greater than or less than the city of Seattle median for each socioeconomic characteristic by year</td>
<td>74</td>
</tr>
<tr>
<td>3.5 The percentage of census block groups belonging to each transition for each socioeconomic characteristic from 1990 to 2010</td>
<td>76</td>
</tr>
<tr>
<td>4.1 Socioeconomic variables collected by the US Census Bureau (Census Bureau, 1990, 2000, 2010). These variables were used to analyze the process of socioeconomic change from 1990 – 2010</td>
<td>118</td>
</tr>
</tbody>
</table>
Chapter 1 - Introduction

This dissertation assesses changes in socioeconomic variables and parks in Seattle, Washington from 1990-2010 to explore causes of gentrification and possible approaches to avoid the negative effects of gentrification. This study tests how the built environment, more specifically urban parks, shape the communities around them. The objectives of this study are:

(1) To gain a better understanding of socioeconomic and racial factors that are associated with gentrification in Seattle, Washington,
(2) To develop a transferrable approach for assessing trajectories of gentrification in urban areas, and
(3) To determine how the spatial distribution of different park types and community investment in parks are associated with gentrification.

The process of gentrification is a complex social, cultural, political, and environmental phenomenon. Therefore, the overall research goal is to identify factors that influence the spatial patterns of socio-economic change in Seattle. The study is structured around three questions:

(1) What are the spatial trends of access to differing publicly owned park types based on differing socioeconomic characteristics from 1990 to 2010?
(2) What is the spatial pattern of gentrification?
(3) How are changes in park access and investment in parks related to trajectories of gentrification?

The dissertation consists of five chapters. Chapter 1 is an overview of the literature that motivated this research, focusing on concepts of environmental justice and how they are related to environmental amenities and parks. It presents the definition of gentrification and reviews competing theories of what causes gentrification, including changes in environmental amenities. The history of the Seattle Parks System and the typology used to classify parks for this study are briefly
described. The theoretical framework used to conceptualize and interpret findings of this research is presented.

Chapter 2 examines spatial trends of access to differing park types and how these trends are related to educational attainment, home value, and income in Seattle, Washington from 1990 to 2000 and 2000 to 2010. Two questions are addressed in this chapter: (1) How were park types distributed in Seattle in 1990 and how have investments in park expansion changed those distribution as of 2000 and 2010? (2) How does park access of varying types differ among census block groups based on educational attainment, home value and income? This chapter sets the stage for examining how environmental justice issues are related to park access.

Chapter 3 presents and applies a method to determine the spatial pattern of gentrification (research question 2). Gentrification is defined based on data from the US Census at the census block group level, and GIS techniques used to define and detect gentrification are described. The resulting maps of gentrification are compared to results from a media content analysis of perceptions of gentrification.

Chapter 4 introduces the concept of environmental gentrification and addresses the third research question: How are changes in park access and investment in parks related to trajectories of gentrification? Relationships among these variables are assessed visually from maps based on GIS overlays. The findings are interpreted to provide insight as to how communities may avoid certain trajectories of gentrification based on community development, cooperation, and investment in parks.

Chapter 5 is an overall conclusion and recommendations for future research.

1. Conceptual Framework
The Society and Land Use model (Platt, 2004) provides a framework for understanding the iterative processes that shape the evolution of cities (Figure 4, adapted from Platt). It depicts the dynamic interactions between the human/cultural landscape, the environmental/physical landscape and the legal realm.

This model provides a framework to examine the dynamic feedback of processes (e.g., gentrification and environmental gentrification) that are influenced by changes
in the physical landscape (e.g., increase or decrease in environmental amenities such as parks), which are in response to or influence changes in the human/cultural landscape (e.g. socioeconomic variables/ parks and land use systems) and the legal realm (e.g. bonds/levies/community directed investment).

This model will help to frame this research because it allows for the characterization of how policies/ park planning affects people and how people inherently feed back into the process.

![Figure 1. The society and land use model (adapted from Platt, 2004).](image)

The circles or data sets are linked with vectors. The resource management vector represents the process by which society organizes the use of land, water, and air (or parks). This vector is representative of both the private and public authorities that together determine how land is used or for example, what types of parks are
created in the landscape and where. The two input vectors (*environmental perception* and *economic* and *social data*) that lead to the legal realm inform decision makers and influence the output of *resource-management*. The environmental perception vector refers to information regarding the state/condition of the physical environment, as it is modified by human activities (the *environmental impacts* vector). In this study the state or condition of the physical environment is characterized by the changes in the amount of park area or the number of parks. The *economic and social data* vector represents feedback on the financial and social effects of a land use, which helps to address question one of this research. For example, the financial capability for a community to influence the type of parks within the landscape, thus influence their access may be related to their differing social and demographic standing compared to other communities. The changes that occur over time to the *economic and social data* vector help to address question two of this research. On the other hand the decisions from the resource management vector that inform what types of parks are associated within certain areas may have an influence on the social and economic vector that feeds back into the legal realm that feed back into the resource management vector from which decisions are made on land use systems, addresses question three of my research. (Platt, p54).

2. Environmental Justice

This research explores environmental justice as it affects where people live and how they interact with parks in a large urban area. The Environmental Protection Agency (EPA) describes Environmental Justice as the “fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to development, implementation, and enforcement of environmental laws, regulations, and policies” (EPA 2001). Executive Order 12898 was enacted in 1994 and signed by President Clinton, which requires that all federal agencies work toward resolving environmental justice issues by identifying and addressing disproportionately high and adverse human health of environmental effects on people with special attention to minority and low-income populations (EPA 1994).
Environmental justice activism began as a grassroots movement in the early 1980s. However, the concepts have been part of the politics of communities of color for more than a century (Taylor 2009). A century ago, environmental activism was marked by people of color banding together to fight for issues including, but not limited to, improvements in housing conditions among slaves, opposition to appropriation of land, erosion of treaty rights, and the share-cropping system (Taylor 2009). These are systematic forms of inequality that inform us about the treatment of the other, based on ideals of race, class, and gender (Anderson and Collins 2013). The environmental justice movement and body of literature thus stem from these experiences and outcomes faced by people of color and make the link between racial and economic inequalities and exposure to environmental hazards.

Studies in the 1980s linked race to exposure to environmental hazards. Two early studies linked demographic patterns to commercial hazardous waste facilities and uncontrolled toxic sites (described in United Church of Christ Commission for Racial Justice 1987). One of these studies found that race was the most significant variable to explain the location of hazardous waste facilities, and income and home values were lower in communities with hazardous facilities compared to those without hazardous facilities. The second report described a concentration of uncontrolled toxic waste sites in Black and Hispanic neighborhoods, particularly in urban areas (United Church Christ Commission 1987). In response to these findings, a number of studies attempted to determine whether the coincidence of toxic waste dumps and minority-dominated neighborhoods was the result of conscious discrimination against vulnerable communities.

One longitudinal analysis of environmental justice revealed that the percentage of African Americans in a census tract was a strong predictor of that tract having a hazardous waste site, but did not show that hazardous sites were being deliberately placed in Black communities. It also showed that working and lower-middle income class neighborhoods had a higher chance of being disproportionately chosen to host hazardous sites (Been and Gupta 1997). This research indicated that environmental justice was not simply a racial issue, but social class was involved as well. For example, people in manufacturing occupations were significantly
associated with hazardous facilities in census tracts (Anderton et al 1994). These studies begin to reveal different effects of race, ethnicity, and class on the siting processes of locally undesirable land uses. The environmental justice literature examines these interrelated issues and how they work together as a system of power and inequality that differentially affects groups depending on their social location (Taylor 2009, Anderson and Collins 2013).

Environmental racism/justice through a systemic lens suggests that while individuals and institutions may not be overtly seeking to create barriers, governance may benefit some at the expense of others (Bolin et al 2002). "White privilege" is a hegemonic form of racism that does not involve forms of hostile or discriminatory acts typically associated with racism, but instead refers to unearned privileges and benefits that are based on an individual’s degree of whiteness (Pulido 2000). Fundamental to the concept of white privilege is the concept of social hierarchy that incorporates cultural and social capital which creates an opportunity for resource mobilization that is solely based on their degree of whiteness. White privilege and processes like it are deeply imbedded in a legacy of racist ideologies, and even if they are not intentional, they perpetuate spatial patterns in which people of color are disproportionately exposed to environmental hazards. Protection from environmental injustice, such as the distribution of hazardous sites, is also linked to the social advantages of being part of a decision-making process, whereas non-whites tend to lack adequate representation in policy and decision making processes (Shrader-Frechette 2002; Agyeman 2005). Rather than invoking questions of environmental racism, these studies appeal to the understanding of local historicized processes of the social structure/institutions, and their racist underpinning that contribute to spatial distribution patterns.

Many studies have sought to understand the historical, place-specific, and institutional structures that create environmental inequalities. Discrimination in housing and occupational opportunities restricted jobs and neighborhoods mainly to whites around the Wagner Electric Plant in St. Louis; in the 1960s, blacks were encouraged to move into the area and encountered a toxic brownfield (Hurley 1997). Historical accounts reveal legacies of discrimination and racism linked to
environmental injustices. For instance, persistent spatial patterns of segregation led to present conditions of whites living closer than blacks to toxic industrial sites in Baltimore, Maryland (Boone et al 2009). This and other studies underscore the importance of historical legacies, which may influence environmental justice (Krieg 2005, Downey 2005, and Saha and Mohai 2005).

Environmental injustice is not limited to exposure to hazardous facilities, but can also involve exposure to other hazards. In Phoenix, lower socioeconomic and ethnic minority groups were more likely to live in neighborhoods with more exposure to heat stress and less shade and green open space to mitigate extreme conditions (Harlen et al 2006). Childhood asthma hospitalization rates in New York City were related to low median household income, high percentage of minorities, public housing, and multiple environmental pollution burdens (Corburn et al., 2006). These environmental justice studies made a conceptual distinction between the presence of environmental hazards and the human health outcome/consequences of the exposure (Harlen et al 2006). Highlighting the connections between environmental hazards and human health outcomes provides a natural link to the injustices related to spatial patterns of environmental amenities.

Recent research in environmental justice has addressed environmental amenities. The term amenity is derived from the Latin word *amoenus*, meaning pleasant. An amenity is a desirable or useful feature, facility, service or resource. The terms "desirable" and "pleasant" imply a sense of value attributed to a feature, service, or resource. Environmental amenities thus are desirable or pleasant features that are built or occur naturally, making the area more desirable. Environmental amenities can include air and water quality, percentage of pervious surface coverage, absence of industry, or proximity to waste sites, type and amount of view (of water, forest, etc.), access to parks or green space, or tree cover (Arnold and Gibbons 1996; Sander and Haight 2012; Boone et al. 2009).

Park spaces are amenities because they provide economic, social, health and ecological benefits. Urban parks are gateways to the natural world and imply a safe city, where people are able to congregate and share their experiences (Burgess et al., 1988). Exposure to nature through parks produces physiological responses, including
lower blood pressure and reduced muscle tension (Urlich 1981). Natural environments with vegetation and water reduce stress in observers compared to urban environments lacking these features (Schroader 1991). Environmental amenities also affect property values, which increase near parks (Crompton 2001). The presence of open space within 1500 ft raised housing property values by more than $2,600 (Bolitzer and Netusil 2000).

Researchers have identified a number of methods for valuing amenities (Sander and Haight 2012). The production function method views the amenity as an input into the production of a marketed good and its value is estimated from the price of that good (e.g., Barbier 2007; Barbier and Strand 1998; Bell 1997; Klemick 2011; Richmond et al. 2007; Sathirathai and Barbier 2001; Simonit and Perrings 2011). Preference approaches use survey results to determine an individual’s willingness to pay for an increase in a service or their willingness to accept compensation for a decrease in a service (e.g., Boyle et al. 1994; Campos et al. 2009; Carson et al. 1992; delSaz-Salazar and Rausell-Köster 2008; Earnhart 2006; McGonagle and Swallow 2005; Sayadi et al. 2009). The replacement cost analysis method uses the price of the least-cost alternative means for providing a service or amenity as a proxy for its value (e.g., Allsopp et al. 2011; Ashendorff et al. 1997; Hougner et al. 2006; Kovacs et al. 2011; NRC 2000). The levels of investment in maintenance of an amenity, such as a park, may indicate the value people place on that amenity; this approach is used in this study.

The spatial distribution of environmental amenities also produces inequalities based on differences in access. A geographic approach to valuing environmental amenities is to simply count or measure the number and area of certain types of features, such as parks, that occur within a given distance of where people live. Furthermore, the spatial distribution of amenities, such as parks, may have deep roots based on historical racism, environmental injustice, and gentrification. This research explores some of these connections.
3. Trajectories of Gentrification

This research is also motivated by controversy over the definition of gentrification and its causes and consequences. Gentrification is described as “the simultaneous phenomena of a physical, economic, social, and cultural change of a city” (Hamnett 1984, p286). Higher income groups move in to neighborhoods previously occupied by lower-income groups, changing the physical, cultural and economic characteristics of the neighborhoods. In US cities, gentrification literature began in the early 1950s and grew rapidly throughout the 1960s. By the 1970s gentrification was evident in many American cities (Smith 1987). As the number of gentrified cities grew so did the literature on the topic.

The early literature on gentrification focused on socioeconomic and cultural effects, displacement and the federal role in redevelopment, benefits of gentrification, and the creation and destruction of communities. Little research addressed the causes and the historical explanations of gentrification. However, over the last 30 years, many scholars have contributed to theories about the causes, explanations and significance of gentrification (Hamnett 1991). Early explanations of gentrification were based on cultural or economic processes (Smith 1987).

3.1 Cultural theories of Gentrification

Lipton (1977) suggested that gentrification was caused by cultural factors. These included a change in lifestyle and declining preferences for life in suburbia, later marriage, fewer children, and younger homebuyers and renters who abandoned the suburban life and redefined themselves in terms of city living. Another cultural explanation for gentrification is that young people, or the “creative class” (Florida 2005) seek to establish socially distinct communities that allow for self-expression and individualism (Winters 1978).

Ley (1978), argued that urban development was less about growth and more about the quality of life for an individual. Drawing from Daniel Bell on post-industrial society and Habermas on advanced capitalism, Ley suggested that ideals of consumption rather than production were dominating patterns of society (Bell 1973, Habermas 1973, Ley 1980). Ley (1980) described gentrification in terms of three
pillars: economy, politics, and culture. Post-industrial society brought with it an economy that was transformed from production of goods to production of services, an increased role of politics in decision-making, and a shift from a focus on individuality to a focus on aesthetics. These three pillars form an emerging class of people (the "gentrifiers"), who form what Veblen (1899) calls the leisure class, and whose lifestyle is driven by status and consumption (Ley 1980). Ley’s (1980) theory helped predict the type of city in which gentrification is likely to occur. However, the theory did not attempt to explain patterns within cities, and it has been criticized for its assumption that gentrifiers determine the urban landscape (Hamnett 1991).

3.2 Economic theories of Gentrification

Gentrification has also been linked to economic factors (Smith 1979). It became more cost effective and profitable to rehabilitate an old neglected home within the city limits than it was to buy a newly constructed residence in the suburbs. Coupled with consumer preference to reduce commuting costs, this provides an explanation for gentrification in economic terms. However, producers as well as consumers of housing influence gentrification (Smith 1979 p.540). Smith (1979) argued that, “To explain gentrification according to the gentrifier’s actions alone, while ignoring the role of builders, developers, landlords, mortgage lenders, government agencies, real estate agents and tenants is excessively narrow.” The "rent gap" theory is based on a related concept: that low rents in neglected neighborhoods provide an opportunity for developers. Smith identifies the gap as the area between the potential rent and the capitalized rent. The potential rent is what could be earned if the building in question was being used at its highest and best use whereas the capitalized rent is the actual rent (Smith (1979). In short the gap grows larger as the conditions of the home and investment for repairs decline. Smith’s theory is well known however, there are criticisms to his theory. One main criticism about this theory is that Smith is firm in the idea that gentrification is production based and market driven and discounts changes in demographics and culture as “surface froth” (Hamnett 1991). Many researchers have challenged this idea and found that “gentrification is unable to exist on its own without the gentrifiers (Hamnett 1991). Researchers like Mullins (1982)
and Beauregard (1986) explain that gentrification is a complex process that must take into account the consumption role of gentrifiers as well as cultural and demographic changes in areas. For instance, they suggest that occupational changes from industrial labor to more professional and managerial workforce are where the gentrifiers exist (Hamnett 1991).

Theories of cultural, economic, and political effects on gentrification are explored in this study. The economic and cultural conditions of a neighborhood may create the potential for gentrification, while politics may influence the process of environmental gentrification. For example, Ley’s cultural and economic pillars coincide to form the gentrifiers, whose focus on aesthetics may increase environmental amenities.

3.3 Environmental Gentrification

A primary motivation for this research is to explore how changes in the environment are related to gentrification. The term "environmental gentrification" was coined by Sieg et al. (2004) who showed that environmental policies aimed to improve the quality of life for residents appeared to only benefit higher income households, because the increases in the housing prices were not fully offset by the air quality improvements that lower income residents can afford to enjoy. Low income households tend to lose out when policies improve environmental quality and initiate the process of environmental gentrification, where wealthy residents move to communities with previously low levels of environmental quality. Housing prices increase, and property owners rather than renters benefit from the policy change that influenced the environmental improvement.

Banzhaf and McMormick (2007) suggested that the concept of environmental gentrification was rooted in Tiebout’s notion of local public goods theory, which provides an indirect explanation for the correlation between minorities and environmental disamenities. Tiebout’s theory suggests that households will sort themselves in different communities based on demands for amenities in the area such as schools or environmental quality (Banzhaf and Walsh 2004). Banzhaf (2007) suggested that, “If we consider environmental quality a normal good, even if all
people have the same tastes, we should expect that lower income households will accept lower environmental quality in exchange for lower housing costs.” Because minority households are typically also low-income they will be associated with lower environmental quality due to the lower housing costs associated with those areas. Research is needed to explore the connection between spatial patterns of environmental amenities and processes of socioeconomic and racial change. This study addressed environmental gentrification by looking at how investments in parks are related to changes in socioeconomic and racial compositions of neighborhoods.

4. Park Planning in Seattle

The process of public park planning influences the spatial distribution of parks and park investment, which in turn may influence environmental justice and contribute to environmental gentrification. The Seattle Department of Parks and Recreation acquires, develops, and maintains parks, recreation programs and other projects with money from levies, donations, nonprofit organizations, grants, bond measures and other funding sources. The process of park planning, implementation, and management is done so primarily by the city however, the backbone of the process is primarily the Seattle citizens. All bonds and levies must be approved by voters, thus the success of the city park is in part due to the valuation that is placed on the park system by the residents of the City Seattle. The creation of Seattle’s park and playground system began in 1884 with a gift of property donated by David T. Denny and his wife. From 1884 to 1904, acquisition of land and creation of new parks was funded through appropriations by the city council and the Freeholders Charter Revenue from fines, fees, and annual tax levies.

In the early 1900s, the Seattle Department of Parks and Recreation received funding through park bonds. Park bonds issued in 1906 ($500,000), and two subsequent bonds issued in 1908 and 1910 ($3 million) were used for the acquisition and development of the Olmstead brother’s park plans. During this time 26 parks and playgrounds were acquired and set the stage for what would be known as a world-class park system. Throughout the 1920s and 30s more park bonds were issued (totaling $889,000), and funds were devoted to development and improvements of
parks. In addition, funds were provided by the Emergency Unemployed Act during the Great Depression and federal aid which provided funding for the development of various recreation sites including: West Seattle Golf, Camp Long, and stadiums. In the 1940s, funding for recreation programs, development and improvements was provided from the federal Lanham Act ($70,000), a state grant ($1,225,000), and a park bond ($2,500,000). Funding in the 1950s was low, because three separate bond issues were defeated by Seattle voters. However, funding rebounded in the 1960s with a bond approval for $4.5 million, a matching funds initiative, and a large park bond for $65 million for acquisition and development of park land. Additional aid was provided through the Forward Thrust program, a bond measure that was passed in 1968 by Seattle and King County voters. This was a capital improvement bond that honed on recreational improvements, acquisition of land and construction of park facilities. During the 1980s, park funding was obtained through a renovation bond issue, and the King County Open Space and Trails bond provided $41 million that was used to purchase and preserve more than 600 acres of land.

Funding for parks in the 1990s was obtained through the Seattle Center Community Center Levy in 1991 ($48.9 million) and 1999 ($72 million). In 1999, Seattle voters approved the renewal of the 1991 levy, renewing Seattle Parks and Recreation’s commitment to renovate and expand old facilities and provide new community centers to underserved areas within the Belltown, Highpoint, International District/Chinatown, Jefferson, Northgate, Sand Point, Southwest, Van Asselt, and Yesler neighborhoods. In 2000 an eight year Pro Parks Levy was approved for $198.2 million for more than 100 different projects including development, acquisition of land, maintenance, recreation programs, and environmental education. Seattle voter’s excitement about Seattle’s public park system was reflected in the passing of the Parks and Green Spaces Levy in 2008. This six-year levy provided $148 million for up to 27 park acquisition projects, more than 60 park improvement projects, and “neighborhood matching” funds for projects that are identified by community groups throughout Seattle neighborhoods (Seattle Parks and Recreation).

This dissertation is relevant to parks and planning because it uses a park typology to explore how access to park types varied by socioeconomic status and
race, and how park access varied over time. Information on neighborhood matching fund investments in parks was analyzed to determine how investment is distributed throughout the Seattle park system.

5. Park Typology
This study defined parks based on their amenities, use (active or passive), and development level of the park. *Active-use* is characterized by the formal playing fields, outdoor or indoor courts, swimming pools, community centers, restroom facilities and/or picnic shelters that are available on site. *Passive-use* is defined as having no formal fields for active play. They tend to have benches, or viewing areas, and trails for walking, biking or hiking. The typology is adapted from King County parks classification system and includes three park types: recreation, natural passive and multiuse parks developed by Weems (2012). Recreation parks are highly developed with formal facilities promoting active play such as play equipment, ball fields, tennis courts, and community centers. These park types often lack an abundance of greenspace, trees and other natural amenities that may be found in other types of parks such as natural passive or multiuse parks. Natural passive parks are characterized by their passive use nature and have no formal fields for active play. They tend to have beaches, viewing areas, and trails for walking, biking or hiking. Multiuse parks are a combination of both recreation and natural passive parks and promote both active and passive use of the area. Differentiating between parks allows for a better understanding of actual distribution and access to amenities within the city.

6. Conclusion:
This research seeks to understand how park access has changed over time and how that access may or may not have an influence over the changes in the economic and social characteristics of neighborhoods (ie: gentrification or environmental gentrification). This research utilizes a modified version of Platt’s Society and Land Use model to help conceptualize the research. Chapter two addresses the access to parks in Seattle over time and the relationship to socioeconomic variables.
7. References


Pulido 2000


Seattle, Parks and Recreation Department - Planning Documents 2009.


Smith 1987

Characteristics of community with hazardous waste sites. NY: Public Data Access, Inquiries to the Commission.


Chapter 2: Access to parks in Seattle: relationship of park type to socioeconomic variables, 1990 to 2010

Abstract
Little is known about how environmental amenities, such as parks, interact with socio-economic and racial characteristics of neighborhoods over time. This study examined the relationships among public park system development over time, park typologies, and socio-economic and racial patterns, in order to understand how park system evolution is related to environmental justice. The spatial trends in access to recreation, natural passive, and multiuse natural parks were determined and related to educational attainment, home value, household income, and race for 481 census block groups in Seattle, Washington from 1990 to 2010. Recreation parks are defined as being highly developed with formal facilities promoting active play. Natural passive parks are characterized by their passive use nature, viewing areas, and trails for walking, biking or hiking. Multiuse parks are a combination of both recreation and natural passive parks and promote both active and passive use of the area. Park access is defined as the number of parks and amount of area within 800m of a Census block group. The study revealed that park access differed among socio-economic groups and by park type. Significantly greater proportions of African Americans and Asians were found in Census block groups with below-median levels of education, income, and home value, which in turn had access to significantly larger numbers and more area of recreation parks. In contrast, census block groups with above-median income, home value and education and significantly fewer minorities had access to greater numbers and more area of natural passive and multiuse natural parks. These patterns did not change much over the study period (1990 to 2010). Park investment had the effect of maintaining differences in park access based on socioeconomic variables, even though new natural passive parks were added to areas formerly lacking natural passive parks. Access to natural passive parks varied by income and home value, but not by education level, implying that educational status and park access are indicators of ongoing demographic changes in neighborhoods. This work raises the question of whether investments in park improvements led or followed the
changes in educational attainment, home value, and income, suggesting that further work is needed to test hypotheses of environmental gentrification in Seattle.

Keywords: environmental justice, environmental gentrification, parks, GIS
1. Introduction and Research Questions

Parks and other natural amenities enhance the quality of life in cities and are a central value in modern society (Burgess, et al. 1988; Kornblum 1987). Parks offer social, mental and physical health as well as economic and environmental benefits. Parks promote social interaction and community development (Moore and Woodrow 1982). Access to parks improves mental health, reduces stress and promotes a sense of tranquility (Urlich 1981; Kaplan 1983; Chiesura 2004, Hartig et al. 1991; Conway 2000; Mass et al. 2009). Parks in urban ecosystems provide increased environmental health through air filtering, microclimate regulation and noise reduction (Bolund and Hunhammar 1999). Property value increases with proximity to parks (Crompton 2001; Espey and Owusu-Edusei 2001; Lutzenhiser and Netusil 2001; Ernst and Young 2003; Troy and Grove 2008; Voicu and Been 2008). Because of their social, economic, and environmental benefits, parks are critical components of publicly owned space in the US (Zhang et al. 2011; Talen 2010; Burgess et al 1988).

1.1. Park typologies

There are many types of parks, and differences among parks may affect how benefits are expressed and who experiences them. Several different park typologies have been proposed based on historical trends, characteristics of surrounding neighborhoods, and other factors.

A historically based typology of parks described four major time periods that coincided with a type of park developed to remedy the social problems of the time (Cranz 1982). These four periods and associated park types were: the pleasure ground (1820 – 1900), the reform park (1900-1930), the recreation facility 1930 – 1965, and the open space concept (1965 - ) (Cranz 1982). Pleasure ground parks, such as those designed by Frederick Olmstead, were established around the edge of the city, and while in theory these parks were created for everyone, in reality this park type were often inaccessible to working class individuals. Therefore, beneficiaries of "pleasure ground" parks were typically upper middle class populations. Reform parks were established between 1900 and 1930, in response to the injustice associated with
the location of the pleasure ground parks and to benefit the wellbeing of the working classes. Reform parks were small, and some featured play equipment for children. Recreation facility parks were based on the establishment of a nationwide effort to extend parks and playgrounds to areas that had not yet received them. The recreation facility era coincided with the establishment of stadiums, parking lots, and asphalt ball courts. During Open Space period, parks promoted free-form play and other activities that would revitalize a city. The open space system helped to transform how parks were used and created a network linked by open space (Cranz and Bolund, 2004).

An alternative park typology is based on the characteristics of the neighborhoods that surround the park, including housing density and income level of the neighborhood (Marcus et al 1998). Parks in areas of low housing density and low to medium income neighborhoods have a typology similar to the recreational facility model described by Cranz (1982). These parks are found in older neighborhoods typically in the suburbs, were developed after World War II, and feature sports facilities and playground equipment. They were established primarily for community gatherings and formal programs.

A third park typology, used in this study, groups parks based on their use (active or passive), and development level of the park. The typology is adapted from King County parks classification system and includes three park types: recreation, natural passive and multiuse parks developed by Weems (2012) (Table 1). Recreation parks are highly developed with formal facilities promoting active play such as play equipment, ball fields, tennis courts and community centers. These park types often lack greenspace, trees and other natural amenities that occur in natural passive or multiuse parks. Natural passive parks are characterized by their passive use nature and have no formal fields for active play. They tend to have beaches, forests, fields, viewing areas, and trails for walking, biking, or hiking. Multiuse parks are a combination of both recreation and natural passive parks and promote both active and passive use of the area. This park typology is useful for assessing the amenities provided by parks.
Table 1. Park classification system based on park use (active or passive), and development level of the park. (Source: Weems, 2012).

<table>
<thead>
<tr>
<th>Park Classification</th>
<th>Use</th>
<th>Development</th>
<th>Park Example</th>
<th>Number of Parks by year</th>
<th>Total Park size (acres) by year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Active</td>
<td>High</td>
<td>Alki playground</td>
<td>124</td>
<td>993.06 1044.73 1082.49</td>
</tr>
<tr>
<td></td>
<td>Passive</td>
<td>Low-medium</td>
<td>Maple school ravine</td>
<td>80</td>
<td>1170.97 1654.14 1737.45</td>
</tr>
<tr>
<td></td>
<td>Active and Passive</td>
<td>medium - high</td>
<td>Warren G. Magnuson Park</td>
<td>64</td>
<td>2804.8 2943.88 3024.45</td>
</tr>
</tbody>
</table>

1.2. Evolution of park systems over time - the role of government

Federal and state governments have influenced the evolution of parks through park funding, which favored the development of certain types of parks in certain places. For example, the Federal Highway Administration's Recreational Trails Program (RTP) provides funding to states to create and maintain recreational trails and trail facilities for hiking, bicycling, inline skating, equestrian riding, all-terrain vehicle riding, and other off-highway motorized vehicles (Federal Highway Administration 2016). State governments have also influenced park systems through certain types of funding. For example, the Washington State Recreation and Conservation Office (RCO), established in 1964, provides grants (matching funds) to state and local agencies, nonprofits, corporations, tribes and private landowners, which can be used to acquire land; develop, restore and/or beautify wildlife habitat; improve outdoor recreation properties; and protect farmland (RCO 2015). Since its inception, the RCO provided $1.7 billion in grants for approximately 7500 projects, and since 1990 it has provided about $60 million for approximately 230 projects annually (RCO 2015). Based on the grant conditions it is plausible to think that the RCO has played a significant role in influencing park development especially regarding the types of parks. For instance restoration and beautification of wildlife habitat may be associated with Natural passive type parks whereas; improvements to outdoor recreation may be targeted to recreation parks.

1.3. Park access and environmental justice

Because park types vary among neighborhoods, park access, (defined as the number of or the amount of area of each park type within 800m of a Census block group) tends to vary among socioeconomic groups. Social factors affect may be
intertwined with ecological conditions of an area (Swyngedouw 1999) and may produce inequities in park access. For example, more white park users of Chicago’s largest park (Lincoln Park) came from neighborhoods nearest to the park, while many Black, Latino, and Asian groups lived farther from the park (Gobster 2002). Low-income areas in Los Angeles with high concentrations of poverty had lower levels of park accessibility and resources (Wolch et al 2005). Education level was significantly positively related to the percentages of green space and urban canopy coverage in Central Indiana (Heynen and Lindsey 2003).

Access to parks and their benefits involves environmental justice, and differences in access to parks among socio-economic groups may involve environmental injustice. Environmental justice activism began as a grassroots movement in the early 1980s, which recognized the connection between racial and economic inequalities and exposure to environmental hazards. A number of studies suggested that low income and minority residents were disproportionately exposed to environmental hazards compared to communities with higher socioeconomic status (e.g. United Church Christ Commission 1987; Been and Gupta 1997). Although the environmental justice literature has primarily focused on environmental disamenities or locally undesirable land uses, recent environmental justice research has expanded to include environmental amenities such as parks.

1.4. Research questions: Park system evolution, park types, and environmental justice

This study examined the relationships among park system development over time, park typologies, and socio-economic and racial patterns, in order to understand how park system evolution is related to environmental justice. Little is known about how park types interact with socio-economic and racial characteristics over time. Researchers have often failed to differentiate between park types when considering park distribution and park accessibility to different socioeconomic groups (e.g. Wolch et al 2005, Boone 2009, Zhou and Kim 2013).

Taking advantage of available data on park size and type, as well as census data from 1990 to 2010, this study examined the spatial trends in access to parks and
their relationship to educational attainment, home value, household income, and race in Seattle, Washington from 1990 – 2010. This study addressed three questions:
1) How were various types of publicly owned parks distributed in Seattle in 1990, and how have investments in the park system changed park distributions from 1990 to 2010?

2) How did access to parks of various types vary among census block groups by educational attainment, home value, and income in Seattle in 1990, 2000, and 2010?

3) How were differences in park access related to racial groups in Seattle in 1990, 2000, and 2010?

1.5. Research hypotheses

Hypothesis 1.1: From 1990 to 2010, park area increased and new parks were established in areas formerly lacking parks.

Hypothesis 1.2: Park investment reinforced unequal access to parks among neighborhoods differing in education, income, and home value.

Parks are created by donation of land, land trading between city departments, or purchasing of new areas. Multiuse and natural passive parks are often donations or purchases of adjacent parcels of undeveloped land, which are available only in certain areas. Recreation parks are also created through land donations, trading, and purchasing of new areas. However in some cases, recreation parks are created when schools close and the playground is converted into a recreation park. Creation of these parks is often dependent on community involvement.

Hypothesis 2.1: Census block groups with higher income, educational attainment and home value had better access to natural passive and multiuse parks compared to census block groups with low income, educational attainment and home value.

Educational attainment, home value, and household income are correlated. Individuals with the ability to pay for amenities such as more green space would be
expected to live in closer proximity to natural passive or multiuse parks compared to those unable to afford such amenities. This is consistent with local public goods theory, which suggests that households will sort themselves in different communities based on demands for amenities in the area such as schools or environmental quality (Banzhaf and Walsh 2004). Multiple studies have shown disparities in access to parks based on socioeconomic status. For example, canopy cover and median household income are positively correlated in Milwaukee, Wisconsin (Heynen et al., 2006). Highly educated neighborhoods tended to have greater canopy coverage/greenspace (Heynen and Lindsey 2003). In this study, natural passive and multiuse parks have more green space than recreation parks, leading to the expectation that they will be associated with high income areas.

Hypothesis 2.2: Census blocks with lower educational attainment, income, and home value had more access to recreation parks compared to census block groups with high income, educational attainment, and home value.

In a previous study on park access and crime in Seattle, found that recreation parks occurred in neighborhoods with lower income, educational attainment and home value (Weems 2012). Other studies have shown strong correlations between park accessibility and income (Boone et al 2009).

Hypothesis 3: Census block groups with household income, home value and educational attainment above the city median had overall higher park access to all park types and lower proportions of minorities compared to census block groups below the city median. These differences were expected to increase over time.

Research has repeatedly shown that race and socioeconomic conditions are interrelated. Large gaps in education persist between minorities and white populations (American Council on Education, 2004). Nonwhite children are more likely to live in poverty than white children (Costello, Keeler, & Angold, 2001; National Center for Education Statistics, 2007). Thus we can expect that minority racial groups will be highly correlated with lower income, education, and, home
value, therefore if the opposite is correlated to more park access of all types we can expect that minorities will have less access to parks.

2. Study site

Seattle, Washington is the largest city in the Pacific Northwest with an area of 217 square km and a population of 608,255 (US Census, 2010). The racial fabric of the city is mostly Whites (69.5 percent), Asians (13.8 percent), and Blacks (7.9 percent). The remaining 8.8 percent includes American Indian and Alaska Native, Native Hawaiian and other Pacific Islanders, and two or more races together. In contrast to the state of Washington as a whole, Seattle is a highly educated city. As of 2010, 57.4 percent of the population age 25 and older held a bachelor’s degree or higher, compared to only 31.9 percent in the state of Washington and 28.8 percent in the US (United States Census Bureau, 2009-2013). However, less than half of the population of Seattle (46.8 percent) owns a home, compared to 63.2 percent in the state of Washington and 64.9 percent in the US. The proportion of households below the poverty line is 13.6 percent, which is comparable to the rest of the state of Washington.

The selection of this study site was based on two key factors:

1. Seattle’s extensive change to its socioeconomic and racial history should be explored in a spatial context. There is a great deal of media attention surrounding this city and its underlying social processes. Seattle’s Central District transformed from predominately working class African American neighborhoods to mostly White, Asian American, and African American professionals, via gentrification (McGee 2008). More recently, Seattle was featured as being one of the “most gentrified cities in America” (Business Insider.com). In February 2014, The Seattle Times reported that “two masked men blocked a Microsoft employee shuttle on Capitol Hill…condemning the neighborhood’s transformation into an ‘upscale yuppie playground’…[with] skyrocketing rents that are displacing less-affluent, longtime residents” (The Seattle Times 2014).
Seattle’s park system dates back to 1884, and consistent city investment has made it leading park system in the world and an ideal place to explore environmental gentrification. Seattle parks are funded in part from Seattle residents, who have strongly supported park development. In recent years voters three levies: the Community Center Levy ($36 million, 1999), the Pro Parks Levy $198 million, 2000), and the Parks and Green Spaces Levy ($145 million, 2008). In addition, the Seattle Department of Parks and Recreation also sought federal, state, and regional funding (Seattle Parks and Recreation, 2014) and has defined a goal of accessibility, to ensure that all residents live within 800m of a park (Harnik 2004).
Figure 1 Census block groups (n=481) in the city of Seattle as defined by the US Census Bureau in 2010.
3. Data sources and Methods

This study used a combination of descriptive and parametric statistics to examine spatial and temporal patterns of parks and socio-economic variables. Descriptive statistics (nearest neighbor and directional distribution ellipses) were used to describe and depict the spatial distributions of park types in Seattle in 1990, 2000, and 2010. Median levels of educational attainment, home value, and household income were determined for the city of Seattle for each of three years: 1990, 2000, and 2010. Each census block group was identified as being above or below the median value for education, home value, and household income in each year. Park access was determined using a GIS-based buffer analysis that identified the number and area of each park type (recreation, natural passive and multiuse parks) within 800m of each census block group boundary. Then, park access values were grouped into above-median and below-median categories based on educational attainment, home value, and household income, for each of three years: 1990, 2000, and 2010. The relationship of park access (numbers and areas of each of three park types) to socio-economic variables (education, home value, and income) and year (1990, 2000, and 2010) was determined using a two-way Analysis of Variance (ANOVA) with the post-hoc Tukey multiple comparisons test. Also, the relationship of minority racial groups (the proportion of population in a census block group that were racial minorities) to socioeconomic variables and year was tested using a two-way ANOVA and Tukey test.

3.1 Socioeconomic data sources

This study used socioeconomic data for the 1990, 2000, and 2010 US census. The data were acquired from the National Historical Geographic Information System through the Minnesota population center, University of Minnesota.

The geographic unit of analysis for all census data was the census block group. A block group is a statistical subset of a census tract, and generally contains between 600 and 3,000 people (US Census Bureau 2012). Each block group is uniquely identified allowing it to be represented graphically with a GIS. As of 2010, Seattle had a total of 481 block groups (Figure 1). In 2000 there were 570 census
block groups, and in 1990 there were 630. Due to the changing boundaries of census block groups over time, this study aggregated the 1990 and 2000 census block group data to the 2010 census block group area based on weighted area. Over time the Census Bureau changes the Census delineations for various reasons for example changes in population size. When changes are made the census data no longer aligns from census year to year. For this study it was important to establish one Census Block group boundary in order to assess all of the data from changing years.

Three socioeconomic variables were selected for this study (Table 2). Variables were based on previous research in the quality of life, environmental justice, environmental gentrification and environmental justice literature (e.g., Jensen 2008, Sieg et al. 2004 and Boone 2009). Median household income and median home value were used to measure the economic status of the population. The percentage of residents 25 and older with bachelor degrees or higher was used as a measure of education (Table 2). In addition, racial groups were considered, including Whites and minorities (Blacks and Asians). It is important to note that many factors may influence changes in the park access, however only four factors were used in this study.

The socioeconomic census data in .csv files and census block groups in shapefile format were downloaded from the National Historical Geographic Information System website. Using ArcGIS10.2.2, the .csv files and shapefiles were imported into the ArcMap data frame. Using the join function, the .csv files and the shapefiles were joined together using their unique identifying object ID number, allowing each census block group to receive its corresponding socioeconomic value.
Table 2. Socioeconomic variables collected by the US Census Bureau (Census Bureau, 1990, 2000, 2010). These variables were used to analyze the process of socioeconomic change from 1990 – 2010.

<table>
<thead>
<tr>
<th>Socioeconomic variables</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race (Whites, Blacks, and Asians)</td>
<td>Percentage of persons belonging to a particular racial group</td>
</tr>
<tr>
<td>Median Income</td>
<td>Median household income in U.S. dollars (with inflation accounted for)</td>
</tr>
<tr>
<td>Median housing value</td>
<td>Median value of owner-occupied housing units in U.S. dollars</td>
</tr>
<tr>
<td>Educational Attainment</td>
<td>Percentage of population age 25+ with high school diploma/ equivalent or bachelor degree or higher as their highest earned degree</td>
</tr>
</tbody>
</table>

3.2. Park data sources

Multiple datasets on parks in Seattle were obtained from the Washington State Geospatial Data Archive (WAGDA) (University of Washington 2007) and King County GIS data portal (University of Washington 2007 and King County GIS 2014). The spatial reference used for all park datasets was Washington State Plane North; FIPS Zone 4601. The units were originally in feet but were converted to meters for this analysis. The shapefiles provided location data as well as attribute information including the parcel identification numbers (PIN), site names, owners, and managers of each park.

Limitations with the park data included missing acquisition dates and missing park parcels. To mitigate the issues the data were examined for inconsistencies, and each dataset obtained from WAGDA and King County GIS was compared with the others to ensure that all parks and their attributes were included. Information regarding park investment and improvement, acquisition dates, historical facts and other anecdotal information pertinent to the overall history of the Seattle park system was obtained from Seattle parks and recreation documentation, Seattle city Archives, and an interview with city of Seattle’s Property and Acquisition Manager.

The park shapefiles were imported into ArcGIS10.2.2. Using the editing function, each park parcel was updated to include accurate acquisition dates, investment amounts and other notable information.
3.3. Defining above- and below-median census block groups

The overall median household income, median home value, and educational attainment were calculated for the City of Seattle for 1990, 2000, and 2010 (Table 3). Each census block group was classified as above (labeled as A) or below (labeled as B) the overall city median for each of these variables in each census decade.

Table 3. City of Seattle overall median for selected socioeconomic characteristics for each decennial census year (1990, 2000, and 2010).

<table>
<thead>
<tr>
<th>Socioeconomic variables</th>
<th>1990</th>
<th>2000</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median household income</td>
<td>$29,353</td>
<td>$45,736</td>
<td>$60,655</td>
</tr>
<tr>
<td>Median home value</td>
<td>$137,900</td>
<td>$259,600</td>
<td>$456,200</td>
</tr>
<tr>
<td>Educational Attainment</td>
<td>38%</td>
<td>42%</td>
<td>56%</td>
</tr>
</tbody>
</table>

3.4. Park types, distribution and access

Each park was classified according to Weems (2012) into one of three categories: recreation, natural passive, or multiuse. The spatial distribution of parks in each year was quantified using the average nearest neighbor analysis to determine if parks were clustered, evenly distributed, or randomly distributed. Nearest neighbor analysis was conducted using ArcGIS10.2.2. The directional distribution (standard deviation ellipse) tool in ArcGIS10.2.2 was used to calculate the mean center of all features and identify if the park parcels by type were trending toward a particular direction. The directional distribution tool creates an ellipse that is centered on the mean center of a group of features. The direction represents the rotation of the long axis measured clockwise from noon. A normal distribution with one standard deviation, which was used in this study, encompasses 68 percent of the all feature centroids (ESRI 2009). This process was used to measure the direction of all park parcels in each of the three park types, for parks established prior to 1990 and park parcels added between 1990 to 2000, and 2000 to 2010.
Access to parks was defined as (1) the number and (2) the area of parks located within 800m of a census block group. Based on studies of park accessibility, the standard distance that people are willing to walk to reach a park is roughly 400m (Forsyth 2000, Nicholls 2001, Lindsey et al. 2001). However, in this study, an 800m buffer in 100m increments was defined from the perimeter of each census block group based on the stated goal of the Seattle Department of Parks and Recreation to ensure that all residents have at least one park within 800m (Harnik 2004).

Researchers measuring access to parks within walking distance suggest using network analyses based on entry points to parks (Liu and Zhu 2004; Zhou and Kim 2013). However, this approach was not feasible for this study because it was impossible to identify specific points of entry for large parks within this dataset. Instead, the number or area of parks of each type within a particular distance was defined as a measure of access to parks, similar to Boone et al. (2009). Using ArcGIS10.2.2, 800m distances from the perimeter of each census block group were generated using the buffer tool set to side type FULL (which generated buffers around the polygons and contains and overlaps the areas within the perimeter of each polygon) and dissolve type NONE (which allowed individual buffers for each polygon to be maintained, regardless of overlap). The number of parks within each 100m-increments (including the parks that may fall within the census block group) up to 800m were counted for all census block groups and for each subset of census block groups above and below the city median for educational attainment, home value, and income.

Another measure of access to parks is the amount of park area within a certain distance of a census block group. Using the buffer tool in Arc GIS 10.2.2, an 800m buffer set to side type FULL (which generated buffers around the polygon and contains and overlaps the areas within the perimeter of the polygon) and dissolve type NONE (which allowed individual buffers for each polygon to be maintained, regardless of overlap) in 100m increments was placed around the perimeter of each census block group. Using the identity tool, each park type was overlaid on the buffers to compute the geometric intersection of the park type and the buffer. The output shapefile provided the area intersection of the two layers in acres.
3.5. Statistical analysis

The statistical significance of differences in park access by education, home value, and income was tested using a two-way ANOVA followed by a post-hoc Tukey’s multiple comparisons test using the R statistical program. The Two-way ANOVA is used to analyze the difference and significance among group means. The Tukey’s multiple comparisons test then identifies pairwise significant differences within the dataset. Dependent variables in the ANOVA were (1) the number of parks within 800m, and (2) the park area within 800m. Independent variables in the ANOVA were census years (1990, 2000, and 2010) and above or below-median groups with respect to education, home value, and income. Pairwise comparisons with a p adjusted value < 0.05 were considered significant.

The statistical significance of racial difference in education, home value, and income was tested using a two-way ANOVA followed by a post-hoc Tukey’s multiple comparisons test using the R statistical program. Dependent variables in the ANOVA were (1) percent African Americans, (2) percent Asians. Independent variables in the ANOVA were census years (1990, 2000, 2010), and above or below-median groups with respect to education, home value, and income.

4. Results

4.1. Park distribution by type and changes in spatial distribution of parks over time

In 1990 there was a total of 268 parks in Seattle, covering 4,969.2 acres (Table 3). Of these, 124 were recreation parks, 80 were natural passive parks, and 64 were multiuse parks (Table 4). In 2010, Seattle had 366 parks covering 5880.3 acres. Of these, 164 (1,082.5 acres) were recreation parks, 126 (1,773.4 acres) were natural passive parks, and 76 (3024.4 acres) were multiuse parks.
Table 4. Numbers and area of parks by type in Seattle in 1990, 2000, and 2010 and park acreage added by decade and park type.

<table>
<thead>
<tr>
<th></th>
<th>Numbers of parks</th>
<th>Park area (acres)</th>
<th>Number of acreage added 1990-2000</th>
<th># of new parks added 2000-2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recreation</td>
<td>124</td>
<td>142</td>
<td>164</td>
<td>18</td>
</tr>
<tr>
<td>Natural passive</td>
<td>80</td>
<td>113</td>
<td>126</td>
<td>33</td>
</tr>
<tr>
<td>Multiuse</td>
<td>64</td>
<td>67</td>
<td>76</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>268</td>
<td>322</td>
<td>366</td>
<td>54</td>
</tr>
</tbody>
</table>

Results of the average nearest neighbor test indicate that recreation and natural passive parks in Seattle were clustered in 2010 (p < 0.0001). However, multiuse parks were randomly distributed.

Park parcels added to the Seattle Park System can be added to existing parks or form brand new parks. From 1990 to 2000, 893 park parcels were added to the Seattle Park System: 49 recreation parcels (51.7 acres), 801 natural passive parcels (483.2 acres), and 43 multiuse parcels (139.1 acres). From 2000 to 2010, 283 park parcels were added to the park system: 42 recreation parks (35.0 acres), 207 natural passive parks (119.4 acres), and 34 multiuse parks (58.3 acres) (Table 4).

In 1990, the mean center of the directional distribution ellipse for recreational parks encompassed center and portions of South Seattle. The ellipse for natural passive parks trended toward northwest Seattle. Multiuse parks were concentrated in the southeast sections of the city along the eastern coastline (Figure 2). From 1990 to 2000, parcels in natural passive parks were mostly added in the southern regions of the city, whereas multiuse parks were added mostly in the northeast, and recreation parks were added mostly to the center of the city (Figure 2 B). From 2000 to 2010, parcels in natural passive parks were mostly added in the southern regions of the city, whereas multiuse park parcels were added mostly in the northwest, and recreation
parks were mostly added in the center of the city (Figure 2 C). Between 1990 and 2010, natural passive and recreation park parcels were added in areas that lacked these park types in 1990 (Figure 2). In contrast, new multiuse park parcels were added to areas that already had this type of park in 1990 (Figure 2).

Figure 2. The directional distribution of different park types added to the Seattle Park System 1990 to 2000 and 2000 to 2010. (a) all parks by type as of 1990, (b) parks added by type from 1990 to 2000, (c) parks added by type from 2000 to 2010.

4.2. Locations of above- and below-median census blocks

From 1990 to 2010, the education level in Seattle increased from a median of 38 to 56% of people aged 25 yrs or older with a Bachelor's degree (Table 2). Over the same period, median home value increased from $137,900 to $456,200, and median household income increased from $29,353 to $60,655 (Table 2). The proportions of census block groups that were above or below the median value did not change significantly from 1990 to 2010 (Table 5). Spatial patterns of above- and below-median census block groups changed only slightly from 1990 to 2010. In 1990 census block groups that were above the city median for household income were
mostly concentrated in north Seattle, and along the Puget Sound, and most of the census block groups below the city median were found in south Seattle (Figure 3-A). These patterns persisted in 2000 and 2010 (Figure 3-B and C).

Table 5. The percentage of census block groups categorized as greater than or less than the city of Seattle median for each socioeconomic characteristic by year.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Educational Attainment</td>
<td>43.5</td>
<td>56.5</td>
<td>50.7</td>
<td>49.3</td>
<td>53.6</td>
<td>46.4</td>
</tr>
<tr>
<td>Median Home Value</td>
<td>40.3</td>
<td>59.7</td>
<td>43.0</td>
<td>57.0</td>
<td>42.8</td>
<td>57.2</td>
</tr>
<tr>
<td>Median Household Income</td>
<td>56.3</td>
<td>43.7</td>
<td>57.4</td>
<td>42.6</td>
<td>55.5</td>
<td>44.5</td>
</tr>
</tbody>
</table>

Census block groups that were above the city median for home value and education also were mostly found along the shores of Puget Sound and Lake Washington and in the mid northern sections of the city, and these patterns persisted in 2000 and 2010 (Figure 4, Figure 5). The number of census block groups with above-median educational attainment increased over time, but this increase was concentrated in the northern and southwest sections of the city (Figure 5).
Figure 3. The spatial distribution of census block groups with household income above or below the median household income in Seattle for 1990, 2000, and 2010.
Figure 4. The spatial distribution of census block groups with home value above or below the median home value in Seattle for 1990, 2000, and 2010.
Figure 5. The spatial distribution of census block groups with educational attainment above or below the median educational attainment in Seattle for 1990, 2000, and 2010.
4.3. Relationships among park area, park type, home value, income, and education

Visual comparisons of distributions reveal some relationships between park types and socio-economic variables (Figures 2 to 5). In 1990, most multiuse and natural passive parks appeared to be located in areas along the shorelines where census block groups were above the overall Seattle median for household income, home value, and educational attainment. However, recreation parks appeared to be located in areas where household income, home value, and educational attainment were below the city median (Figures 2-A, 3-A, 4-A, and 5-A).

From 1990 to 2000, recreation park parcels added to the Seattle park system were primarily located in areas that were below the city median for household income, home value, and educational attainment. Multiuse park parcels were primarily added to areas along the shorelines and sections of south Seattle, in census block groups above the city median for educational attainment and home value, but below the Seattle median for household income. Natural passive park parcels were primarily added in south Seattle, within narrow corridors that were above the city median for household income and below the median for educational attainment and home value (Figures 2-B, 3-B, 4-B, and 5-B).

From 2000 to 2010, recreation park parcels were mostly added near downtown Seattle and extending into southern and northern Seattle. These new or expanded recreation parks were located in census block groups that were above the Seattle median for household income and educational attainment, but below the median for home value. Natural passive parks were mostly added in the southeast and southwest sections of the city in census block groups that were below the Seattle median for household income, home value and educational attainment and also in some narrow corridors of above-median census block groups. Multiuse parks were added in the northwest section of the city and coincided with areas that were above the city median for household income, home value and educational attainment (Figures 2-C, 3-C, 4-C, and 5-C).
4.4. Access to Recreation Parks and change over time by education, home value, and income

Statistical analysis of park access data confirms the relationships of socio-economic variables to park type distributions and changes in park distributions over time. Overall, the numbers of recreation parks was significantly higher (4 or 5 parks vs. 3 parks) for census block groups that were below the median in household income in 1990, 2000, and 2010. However, numbers of recreation parks did not differ significantly among census block groups based on home value or education.

Numbers of recreation parks increased significantly from 1990 to 2000 for census block groups that were below the median for education and from 2000 to 2010 for census block groups that were below the median for home value and household income (Table 5). In contrast, the number of recreation parks did not change from 1990 to 2000 for above-median census block groups, but it increased significantly from 2000 to 2010 for census block groups that were above the median in education and household income (Table 5).

The area of recreation parks was significantly higher (roughly twice) for census block groups that were below the median in education in 1990, 2000, and 2010, and for those that were below the median for home value in 2000 and 2010. However, the area of recreation parks did not differ significantly among census block groups based on household income. There were no significant changes in recreation park area based on education, home value, or household income from 1990 to 2010 (Table 6).
Table 6 Mean number of recreation parks within 800m of census blocks groups above or below Seattle median for each socioeconomic category 1990 – 2010.

<table>
<thead>
<tr>
<th>Years</th>
<th>Above/ below</th>
<th>Educational Attainment</th>
<th>Median Home Value</th>
<th>Median Household Income</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>n</td>
<td>Mean</td>
<td>n</td>
</tr>
<tr>
<td>1990</td>
<td>above</td>
<td>209</td>
<td>3.2a</td>
<td>194</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>272</td>
<td>3.7a</td>
<td>287</td>
</tr>
<tr>
<td>2000</td>
<td>above</td>
<td>244</td>
<td>3.4a</td>
<td>207</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>237</td>
<td>4.6b</td>
<td>274</td>
</tr>
<tr>
<td>2010</td>
<td>above</td>
<td>258</td>
<td>4.3b</td>
<td>206</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>223</td>
<td>4.9b</td>
<td>275</td>
</tr>
</tbody>
</table>

Group means in the same column followed by the same letter are not significantly different from each other according to Tukey's multiple comparison of means with 95% family-wise confidence level.

Table 7 Group means for recreation park area within 800m of census block groups above or below Seattle median for each socioeconomic category 1990-2010.

<table>
<thead>
<tr>
<th>Years</th>
<th>Above/ below</th>
<th>Educational Attainment</th>
<th>Median Home Value</th>
<th>Median Household Income</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>n</td>
<td>Mean</td>
<td>n</td>
</tr>
<tr>
<td>1990</td>
<td>above</td>
<td>209</td>
<td>12a</td>
<td>194</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>272</td>
<td>22b</td>
<td>287</td>
</tr>
<tr>
<td>2000</td>
<td>above</td>
<td>244</td>
<td>12a</td>
<td>207</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>237</td>
<td>27b</td>
<td>274</td>
</tr>
<tr>
<td>2010</td>
<td>above</td>
<td>258</td>
<td>14a</td>
<td>206</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>223</td>
<td>27b</td>
<td>275</td>
</tr>
</tbody>
</table>

Group means in the same column followed by the same letter are not significantly different from each other according to Tukey's multiple comparison of means with 95% family-wise confidence level.

4.5. Access to Natural Passive Parks and change over time by education, home value, and income

Overall, the numbers of natural passive parks was significantly higher for (2 or 3 parks vs. 1 park) for census block groups that were above the city median for education, home value and household income in 1990, 2000, and 2010. However, numbers of natural passive parks did not differ significantly among census block
groups based on household income in 1990. Numbers of natural passive parks increased significantly from 1990 to 2000 for census blocks that were below the median for educational attainment and home value, but they did not increase significantly from 2000 to 2010 for census block groups that were below the median for educational attainment, home value, and household income (Table 7).

The area of natural passive parks was significantly higher (roughly twice) for census block groups that were above the median in household income in 1990, 2000, and 2010, for those that were above the median for education in 1990, and for those that were above the median for home value in 1990 and 2000. However, the area of natural passive parks did not differ significantly among census block groups based on educational attainment from 2000 to 2010. There were no significant changes over time in natural passive park area for census block groups that were above the median for educational attainment. However, natural passive park area increased significantly from 1990 to 2000 (but not from 2000 to 2010) for census block groups that were above and below the median for home value and household income (Table 8).

Table 8 Mean number of natural passive parks within 800m of census blocks groups above or below Seattle median for each socioeconomic category 1990 – 2010

<table>
<thead>
<tr>
<th>Years</th>
<th>Above/ below</th>
<th>n</th>
<th>Mean</th>
<th>n</th>
<th>Mean</th>
<th>n</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>above</td>
<td>209</td>
<td>2.4b</td>
<td>194</td>
<td>2.5b</td>
<td>271</td>
<td>2.2a</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>272</td>
<td>1.7a</td>
<td>287</td>
<td>1.6a</td>
<td>210</td>
<td>1.7a</td>
</tr>
<tr>
<td>2000</td>
<td>above</td>
<td>244</td>
<td>3.0cd</td>
<td>207</td>
<td>3.9c</td>
<td>276</td>
<td>3.1b</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>237</td>
<td>2.5bd</td>
<td>274</td>
<td>2.3b</td>
<td>205</td>
<td>2.3ac</td>
</tr>
<tr>
<td>2010</td>
<td>above</td>
<td>258</td>
<td>3.3ce</td>
<td>206</td>
<td>3.5c</td>
<td>267</td>
<td>3.4b</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>223</td>
<td>2.8be</td>
<td>275</td>
<td>2.8b</td>
<td>214</td>
<td>2.7c</td>
</tr>
</tbody>
</table>

Group means in the same column followed by the same letter are not significantly different from each other according to Tukey's multiple comparison of means with 95% family-wise confidence level.
4.6. Access to Multiuse Parks and change over time by education, home value, and income

Overall, the numbers of multiuse parks was significantly higher for (2 parks vs. 1 park) for census block groups that were above the city median for education, home value and household income in 1990, 2000, and 2010. Numbers of multiuse parks did not increase significantly from 1990 to 2010 for census block groups that were above or below the median for educational attainment and household income; however they did increase significantly from 2000 to 2010 for census block groups that were below the median for home value (Table 9).

The area of multiuse parks was significantly higher (roughly twice) for census block groups that were above the median for education, home value and income in 1990, 2000, and 2010. There were no significant changes in multiuse park area from 1990 to 2010 (Table 10).
Table 10 Mean number of multiuse parks within 800m of census blocks groups above or below Seattle median for each socioeconomic category 1990 – 2010

<table>
<thead>
<tr>
<th>Years</th>
<th>Above/ below</th>
<th>Educational Attainment</th>
<th>Median Home Value</th>
<th>Median Household Income</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Mean</td>
<td>n</td>
<td>Mean</td>
</tr>
<tr>
<td>1990</td>
<td>above</td>
<td>209 2.0a</td>
<td>194 2.1a</td>
<td>271 1.8a</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>272 1.3b</td>
<td>287 1.3b</td>
<td>210 1.3b</td>
</tr>
<tr>
<td>Multiuse</td>
<td>above</td>
<td>244 2.1a</td>
<td>207 2.3a</td>
<td>276 2.0a</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>237 1.3b</td>
<td>274 1.2b</td>
<td>205 1.4b</td>
</tr>
<tr>
<td>2010</td>
<td>above</td>
<td>258 2.1a</td>
<td>206 2.3a</td>
<td>267 2.1a</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>223 1.6b</td>
<td>275 1.6c</td>
<td>214 1.7b</td>
</tr>
</tbody>
</table>

Group means in the same column followed by the same letter are not significantly different from each other according to Tukey’s multiple comparison of means with 95% family-wise confidence level.

Table 11 Group means for multiuse park area within 800m of census block groups above or below Seattle median for each socioeconomic category 1990-2010.

<table>
<thead>
<tr>
<th>Years</th>
<th>Above/ below</th>
<th>Educational Attainment</th>
<th>Median Home Value</th>
<th>Median Household Income</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Mean</td>
<td>n</td>
<td>Mean</td>
</tr>
<tr>
<td>1990</td>
<td>above</td>
<td>209 2.0a</td>
<td>194 2.1a</td>
<td>271 1.8a</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>272 1.3b</td>
<td>287 1.3b</td>
<td>210 1.3b</td>
</tr>
<tr>
<td>Multiuse</td>
<td>above</td>
<td>244 2.1a</td>
<td>207 2.3a</td>
<td>276 2.0a</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>237 1.3b</td>
<td>274 1.2b</td>
<td>205 1.4b</td>
</tr>
<tr>
<td>2010</td>
<td>above</td>
<td>258 2.1a</td>
<td>206 2.3a</td>
<td>267 2.1a</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>223 1.6b</td>
<td>275 1.6c</td>
<td>214 1.7b</td>
</tr>
</tbody>
</table>

Group means in the same column followed by the same letter are not significantly different from each other according to Tukey’s multiple comparison of means with 95% family-wise confidence level.
4.7. Trends in park access over time by socioeconomic group

Differences in park access in all three decades were largest based on household income (Tables 5 to 10). In 1990, census block groups that were above the median for household income had access to 1.7 fewer recreation parks and 0.5 more natural passive and multiuse parks compared to census block groups that were below the median for household income. In 2010, census block groups that were above the median for household income had access to 1.3 fewer recreation parks, and 0.7 more natural passive parks, and 0.4 more multiuse parks compared to census block groups that were below the median for household income (Figure 6).

However, park access differences in terms of area tell a different story. In 1990, census block groups that were above the median for household income had access to more area of all types of parks compared to census block groups that were below the median for household income (Figure 7). Moreover, by 2010, although census block groups that were above the median for household income had access to slightly less area of recreation parks, they had access to the same area of natural passive parks, and to increased area of multiuse parks (Figure 7).

Figure 6. Differences in the average numbers of parks available to above- versus below-median census block groups based on household income over time in Seattle.
Figure 7. Differences in the average area (m) of parks available to above- versus below-median census block groups based on household income over time in Seattle.

4.8. Relationship of park access to race

Census block groups that were below the median for educational attainment, home value, and income had significantly higher percentages of blacks (by 10 percentage points) compared to census block groups that were above the median, in 1990, 2000, and 2010 (Table 11). Census block groups that were below the median also had significantly higher percentages of Asians (by 6 to more than 10 percentage points) compared to census block groups that were above the city median in 1990, 2000, and 2010 (Table 12). From 1990 to 2000, the percentage of blacks and Asians above and below the median for all socioeconomic characteristics did not significantly change. However, from 2000 to 2010, the percentage of African American means decline for above median for all characteristics declined, in contrast Asians slightly increased in census block groups above the median for all characteristics (Table 11 and 12).
Table 12 Group means for percentage of African American racial group belonging each census block groups that is above or below the median for each socioeconomic category 1990-2010.

<table>
<thead>
<tr>
<th>Years</th>
<th>Above/ below</th>
<th>n</th>
<th>Mean</th>
<th>n</th>
<th>Mean</th>
<th>n</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>above</td>
<td>209</td>
<td>4.2a</td>
<td>194</td>
<td>4.3a</td>
<td>271</td>
<td>5.9a</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>272</td>
<td>14.8b</td>
<td>287</td>
<td>14.1b</td>
<td>210</td>
<td>15.7b</td>
</tr>
<tr>
<td>2000</td>
<td>above</td>
<td>244</td>
<td>3.4a</td>
<td>207</td>
<td>4.3a</td>
<td>276</td>
<td>5.7a</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>237</td>
<td>13.4b</td>
<td>274</td>
<td>11.4b</td>
<td>205</td>
<td>11.8bc</td>
</tr>
<tr>
<td>2010</td>
<td>above</td>
<td>258</td>
<td>2.8ac</td>
<td>206</td>
<td>2.9a</td>
<td>267</td>
<td>4.4a</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>223</td>
<td>13.6b</td>
<td>275</td>
<td>11.5b</td>
<td>214</td>
<td>12.1c</td>
</tr>
</tbody>
</table>

Group means in the same column followed by the same letter are not significantly different from each other according to Tukey's multiple comparison of means with 95% family-wise confidence level.

Table 13 Group means for percentage of Asian racial group belonging each census block groups that is above or below the median for each socioeconomic category 1990-2010.

<table>
<thead>
<tr>
<th>Years</th>
<th>Above/ below</th>
<th>n</th>
<th>Mean</th>
<th>n</th>
<th>Mean</th>
<th>n</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>above</td>
<td>209</td>
<td>6.4a</td>
<td>194</td>
<td>5.6a</td>
<td>271</td>
<td>9.3a</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>272</td>
<td>15.0b</td>
<td>287</td>
<td>15.1b</td>
<td>210</td>
<td>14.0b</td>
</tr>
<tr>
<td>2000</td>
<td>above</td>
<td>244</td>
<td>7.0c</td>
<td>207</td>
<td>6.2a</td>
<td>276</td>
<td>10.0a</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>237</td>
<td>19.0d</td>
<td>274</td>
<td>18.0b</td>
<td>205</td>
<td>16.8b</td>
</tr>
<tr>
<td>2010</td>
<td>above</td>
<td>258</td>
<td>8.4c</td>
<td>206</td>
<td>7.2a</td>
<td>267</td>
<td>10.2a</td>
</tr>
<tr>
<td></td>
<td>below</td>
<td>223</td>
<td>19.2bd</td>
<td>275</td>
<td>18.1b</td>
<td>214</td>
<td>17.5b</td>
</tr>
</tbody>
</table>

Group means in the same column followed by the same letter are not significantly different from each other according to Tukey's multiple comparison of means with 95% family-wise confidence level.
5. Discussion

5.1. Park access and socioeconomic variables in Seattle

This study showed that park access varied significantly among socio-economic and racial groups in Seattle, and in some cases differences in access were enhanced, rather than reduced, over time. We expected to find that census block groups that were below the median for educational attainment, home value, and income had greater access to the number and area of recreation parks within 800m. As expected, we found that access varies as a function of educational attainment, home value, and household income in Seattle. Census block groups that were below the median for educational attainment and home value had greater access to the number of recreation parks within 800m in 2010, but not in 1990 and 2000, when access was equal. Although census block groups that were below the median for household income had access to a greater number of recreation parks within 800m, they did not have access to more recreation park area. Instead, recreation park area access did not differ between census block groups that were above and below the median for household income.

expected above the city median census block groups for educational attainment, home value, and household income would have greater access to natural passive and multiuse parks. We did not find support for census block groups above the city median for educational attainment having greater access to natural passive parks. Instead we found that census block groups above and below the city median for educational attainment had equal access to the number and area of natural passive parks within 800m.

5.2. Methodological issues

As suggested by Boone et al (2009) and Zhou and Kim (2013), using park acreage as a measure of access can tell a different story than solely measuring access by counts of parks within a certain distance and can reflect the variability in park access. In Baltimore, although Blacks had more parks within a quarter mile, they had
access to less area of parks than white neighborhoods (Boone et al. 2009). In this study suggest that there is no difference in terms of counts compared to area.

Previous authors have ignored park types, which can obscure important differences. In a study of Milwaukee, Wisconsin, by distinguishing public from private parks, Heynen et al. (2006) were able to show that canopy coverage in neighborhoods was based on purchasing ability, rather than lack of public funding for trees. Examining park access by park types also reveals the different kinds of benefits parks provide to different socioeconomic groups. For example, in this study above-median census block groups had access to more natural passive and multiuse parks, but fewer recreation parks.

5.3. Changes in park distribution over time - the role of park investment

Park investment in Seattle from 1990 to 2010 had the effect of maintaining differences in park access based on socioeconomic variables. We expected to find an overall increase in park area over time, and creation of new parks, or expansion of existing parks, in areas formerly lacking parks. As expected, park area increased for all park types from 1990 to 2010. However, no new recreation parks or multiuse parks were added to areas formerly lacking those types of parks. In 1990, recreation parks were clustered in the northwest, east, and southwest sections of the city, but they were scarce in the southeast region. From 1990 to 2010, most recreation parks added to the Seattle park system had at least one other recreation park within 800m. In 1990, multiuse parks were clustered in the central and northern sections, but they were scarce in the southern sections of the city. Over half of the multiuse park parcels added to the park system from 1990 to 2000 and 70% of the parcels added from 2000 to 2010 expanded pre-existing parks in the central and northern sections of the city.

In contrast, new natural passive parks were added to areas formerly lacking natural passive parks. Most of these additions were expansions of existing parks, but in some cases, new park parcels were established in areas formerly lacking natural passive parks. For example, the West Duwamish Greenbelt was extended from 15 to 120 acres between 1990 and 2000. The East Duwamish Greenbelt also was extended.
These additions shifted the overall distribution of natural passive parks toward areas that formerly lacked parks of this type and is linked to Seattle’s prioritization due to it being a critical link in the wildlife habitat corridor.

The lack of change in spatial patterns of recreation and multiuse parks, compared to the expansion of natural passive parks, is attributable to the plans, funding, and park policies of the City of Seattle and King County. In 1988, the city of Seattle adopted a revised Comprehensive Plan and policies involving open space (enacted in 1990), which established long-term open space goals. A Comprehensive Open Space Program was developed, which included: (1) establishing a continual funding source for acquisition of land, (2) seeking funding for maintenance expenses, and (3) use of non-purchasing options such as donations, land trades, etc. The plan also addressed public and private greenspace development, by targeting the acquisition of areas accessible to a large number of people or having special features such as streams, wooded hillsides, and/or historic landscapes (Resolution 27852 1988). The Open Space and Trails program targeted 27 greenbelts and natural areas, and by 1998 about 600 acres of land had been preserved. The acquisition of land was achieved through outright purchases and non-purchasing methods including donations and land transfers, as well as funds from the 1989 King County Open Space and Trails Bond, passed in 1989. This bond initially provided Seattle with $41 million but the budget grew to nearly $100 million (Seattle Parks and Recreation 2010). Thus, these policies of the city of Seattle and King County, which focused on growth of natural passive park lands, explain the trends in natural park distribution observed in this study.

Spatial and temporal patterns of access to multiuse parks also can be explained in part by patterns of investment in parks. Census block groups above the city median for all variables had greater access to multiuse parks in 1990, 2000, and 2010. Over 80% (113 of 139 acres) of new multiuse park parcels added to the 2,405 acres of multiuse parks in the Seattle park system from 1990 to 2010 extended previously existing parks in areas mostly bordering the Puget Sound and Lake Washington coastlines, whose neighboring census block groups are above the median for all socioeconomic characteristics. Also, 80% (40 of 58 acres) of multiuse
parkland added to the park system in 2000 to 2010 extended previously existing parks located along the shoreline that serve wealthy, highly educated communities. This suggests that investment in multiuse parks might be disproportionately beneficial to communities that are wealthy and highly educated. This topic is explored further in Chapter 4.

5.4. Disparities in park access and environmental justice

This study found that census block groups with below-median levels of household income and home value consistently had less access to multiuse natural and natural passive parks, and greater access to recreation parks than above-median census block groups, and that these patterns did not change from 1990 to 2010. Because census block groups that were below the median for educational attainment, home value and household income had significantly greater proportions of minorities than census block groups that were above the city median, census block groups with high proportions of minorities have significantly less access to multiuse and natural passive parks in Seattle.

Many studies have shown that ‘green public open spaces’ (similar to natural passive parks) are smaller in poor areas (Talen 1997; Cutts et al. 2009). This study provides a novel finding that although less area of natural passive parks is available to census block groups that were below the median for home value and income, nevertheless access to natural passive park acreage increased significantly from 1990 to 2010 from 9 to 21 acres, 7 to 18 acres, and 5 to 13 acres, in census block groups that were below the median for education, home value and income, respectively.

The finding that greater numbers of recreation parks tend to be nearer to communities below the median could be considered an injustice. Based on the typology natural passive and multiuse parks provide more green amenities than do recreation parks. For example if we understand certain park types to provide more ecosystem services such as air and nose filtering based on the percentage of canopy coverage, many recreation parks would not meet the criteria for providing these services.
5.5. Changes in park access and implications for gentrification

Surprisingly, both above and below city median census block groups for educational attainment had equal access to the number and area of natural passive parks within 800m. The finding that access to natural passive parks varied by income and home value, but not by education level, may indicate that educational status and park access are indicators of ongoing demographic changes in neighborhoods. In this study, natural passive parks expanded in south Seattle, where many census block groups have below-median home value and income, but where education levels may be rising. This is similar to a study which found that census block groups with higher education and higher income were typically associated with a greater tree canopy (as expected to see in natural passive park types) in six cities in Illinois (Zhou and Kim 2013).

Park distribution is a legacy of past demographics combined with recent park development and investment, indicative of a dynamic city system. Differing park types appear to be part of this process and are connected to income, home value and race. Although adding multiuse or natural passive parks in areas previously lacking access might benefit the neighborhood, it may also be a problem if it leads to increases in home value and income that displace residents and change the fundamental characteristics of the neighborhood. This process is called gentrification and is explored further in Chapter 3.

5.6. Implications for park planning

Despite an overall increase in access to parks in Seattle, and a slight reduction in the disparity of access to natural passive parks, the overall disparity of access to parks between above- and below-median groups, and between white vs. minority-dominated neighborhoods, did not change from 1990 to 2010. Most additions to park area were quite small, especially for multiuse parks, which partly explains why park access has not changed much over time. However, constraints on available land also may explain these results. Seattle’s land area may not allow for large parks to be established in areas that were previously lacking larger parks. Limited land area in highly developed areas may preclude the establishment of all parks except small
recreation or multiuse parks. Park planning focused on park additions and improvements in areas that are lacking park access could address some of the inequities.

All in all it is important to consider the equity of distribution in the planning process for a number of reasons. The disparity in park access raises questions about environmental justice. Traditional environmental justice literature has focused on the distribution of environmental bads, however the literature has developed to also include fair distribution of environmental goods such as quality air, water, and parks. The distribution of environmental goods may also be linked to issues surrounding gentrification and environmental gentrification. The results of this analysis appear to show a trend that educational attainment and home value increased in areas where income was already above the mean. This may suggest that economic factors like income may lead to improvements in education and home value which have been suggested to be related with park access. Access to multiuse and natural passive parks was higher for the white racial group, which also had higher home value, educational attainment, and household income, raising the question of whether investments in park improvements led or followed the changes in educational attainment, home value, and income. The environmental gentrification theory should be tested to further understand how park access may or may not impact communities.

6. Conclusion

The results of this study clearly show that access to different park types is not uniform across the city of Seattle. The socioeconomic fabric of certain census block groups determines access to different park types. Access to parks within walking distance is not evenly distributed throughout the city. On average greater numbers of recreation parks within walking distance are available to neighborhoods having lower incomes, lower home values and lower percentages of college degree holders. In contrast, natural passive and multiuse parks are more available to neighborhoods with socioeconomic characteristics above the city median. These results are similar to other studies, which found disparities in access to parks between neighborhoods of varying socioeconomic status (Gobster 2002, Timperio et al 2007, and Boone et al
2009). This and other studies have also confirmed that park access differs among racial groups. Blacks and Asians more frequently inhabit census block groups that are below the city median for educational attainment, home value, and household income, have greater access to recreation parks, but lack access to multiuse and natural passive parks.

Overall, the distribution of parks and varying access to each park type in Seattle brings light to the complex interactions between socioeconomic status and planning efforts for the placement of newly added parks over time. It can be challenging to change or reduce disparities in park access over time due to limits of available land, zoning, and other budgetary issues.
7. References


8. Appendix

The frequency and distribution of educational attainment for census block groups in Seattle Washington for the 1990, 2000, and 2010 census years.
The frequency and distribution of median household income for census block groups in Seattle Washington for the 1990, 2000, and 2010 census years.
The frequency and distribution of median home value for census block groups in Seattle Washington for the 1990, 2000, and 2010 census years.
Chapter 3

Spatial patterns of gentrification in Seattle: multifaceted, dynamic interactions

Abstract

Mapping of gentrification is a necessary first step in order to test hypotheses about causes and consequences of gentrification. The availability of digital spatial data, including census data as well as spatially explicit media coverage, provides the opportunity to develop and test an approach to mapping gentrification in Seattle over the period 1990 to 2010. Gentrification was defined as change from below to above the median value for education, income, and home value in a census block group over the period 1990 to 2000 or 2000 to 2010. These patterns were compared to changes in proportions of minorities and perceptions of gentrification in the media over those time periods. Nine percent of census block groups met the definition of gentrification in each of the two decades. Gentrification was clustered in central, north and west Seattle. In Central Seattle these changes were accompanied by large declines in the proportion of African Americans in the population. However, gentrification in terms of education, income, and home value also occurred in areas that did not have large proportions of minorities. Gentrification was spatially contagious: it was more likely to occur in census block groups that were adjacent to previously gentrified census block groups. Media perceptions of gentrification were reported in places that met the definition of gentrification, but also in areas experiencing changes in minorities, but which did not yet meet the definition of change in terms of education, home value, and income. These findings demonstrate that gentrification is a multi-dimensional, spatially contagious, dynamic process, and gentrification may not always lead to displacement of minorities. More work is needed to understand the causes of gentrification, especially the role of environmental amenities.

Keywords: gentrification,
1. Introduction and Research Questions

Urban areas have strongly defined spatial patterns of wealth and race, which are often correlated, and they are dynamic. While some parts of an urban landscape may be invariant over time, other parts may experience rapid and dramatic change. Neighborhoods experience change over time in demographic characteristics, such as income, home value, and education levels, as well as racial and ethnic composition. When a relatively poor neighborhood experiences increasing wealth, and this forces minorities to move out, the process is described as "gentrification" (Glass 1964, Smith 1982; Kendig 1984; Williams 1984). Gentrification is considered to be a form of social injustice, because it disproportionately disadvantages poor and minority groups. It may also lead to feelings of loss, anger, and fear in neighborhoods that are gentrifying (Smith 1996). Moreover, urban planning significantly influences spatial patterns of gentrification (Smith 2002). Therefore, explicit spatial information about the patterns of gentrification is useful both for understanding its causes and consequences and for urban planning.

Despite widespread discussion of gentrification in the scholarly literature and in the popular media, few standard approaches exist to map and describe gentrification. Mapping of gentrification is a necessary first step in order to test hypotheses about causes and consequences of gentrification. Maps of gentrification have been constructed based on quantitative vs. qualitative information and objective vs. subjective classification. For example, in Seattle, gentrification has been mapped based on changes in census data including population, race, persons with college degrees, income, age, housing values, and differences in housing types and composition (Morrill 2003). Other studies map gentrification based on qualitative information such as cultural changes and shifts in demographics, such as ethnic culture change over to white culture (Anderson 1990; Maurrasse 2006).

Seattle, in the state of Washington, USA, has experienced demographic change in many neighborhoods, and some of this change has been described as gentrification. Seattle’s Central District transformed from predominantly working class African American neighborhoods to mostly professional White, Asian American, and African Americans from 1990 to 2000 (McGee 2008). More recently,
Seattle was described as one of the “most gentrified cities in America” (Business Insider.com). In February 2014, The Seattle Times reported that “two masked men blocked a Microsoft employee shuttle on Capitol Hill…condemning the neighborhood’s transformation into an ‘upscale yuppie playground’…[with] skyrocketing rents that are displacing less-affluent, longtime residents” (The Seattle Times).

The availability of digital spatial data, including census data as well as spatially explicit media coverage, provides the opportunity to develop and test an approach to mapping gentrification in Seattle. This study has the following objectives:

(1) Develop a definition of gentrification based on socioeconomic data (income, home value, education, race) and apply this definition to map gentrification in Seattle from 1990 to 2000, and 2000 to 2010.

(2) Test how patterns of change in income, home value, and education are related to spatial patterns of change in African American and Asian populations and to media reports of gentrification.

(3) Infer how results help refine understanding of gentrification and its relationship to patterns of socio-economic and demographic change in Seattle.

Hypothesis 1: Gentrification is more likely in neighborhoods with relatively low income, home value, and education, as well as high proportions of minorities. Socioeconomic characteristics such as low income, home value and educational attainment have been linked to gentrification (Vigdor 2002).

Hypothesis 2: Gentrification is more likely in locations adjacent to areas that gentrified in a previous time period. Based on Tobler’s first law, it is likely that gentrification would occur in areas adjacent to where it previously occurred.

Hypothesis 3: Increases in income, home value, and education coincide with declines in proportions of minorities.
Hypothesis 4: Media accounts perceive gentrification in places that experience declines in populations of minorities, but not in places that only experience changes in education, home value, and income. Qualitative accounts may be equally, if not more effective than quantitative analysis of socioeconomic variables for identifying gentrification (Barton 2016).

2. Study Site

Seattle, Washington, is the largest city in the Pacific Northwest with an area of 217 sq km and a population of 608,255 (US Census, 2010). The racial fabric of the city is mostly Whites (69.5 percent), Asians (13.8 percent), and Blacks (7.9 percent). American Indian and Alaska Native, Native Hawaiian and other Pacific Islanders, and two or more races together make up the remaining 8.8 percent. In contrast to the state of Washington as a whole, Seattle is highly educated. As of 2010, 57.4 percent of the population age 25 and older held a bachelor’s degree or higher, compared to only 31.9 percent in the state of Washington and 28.8 percent in the US (United States Census Bureau, 2009-2013). However, less than half of the population of Seattle (46.8 percent) owns a home, compared to 63.2% in the state of Washington and 64.9 percent in the US. The proportion of households below the poverty line is 13.6 percent, which is comparable to the rest of the state of Washington.

3. Data sources and Methods

This study involved (1) developing a definition of gentrification based on socioeconomic data (income, home value, education, race) and applying this definition to map gentrification in Seattle from 1990 to 2000, and 2000 to 2010; (2) comparing this map to spatial patterns of change in African American populations; and (3) conducting a content analysis to identify the spatial coordinates of media reports of gentrification.

3.1 Data sources

Racial and socioeconomic data were obtained from the 1990, 2000, and 2010 US Census. The data were acquired from the National Historical Geographic...
Information System (NHGIS) through the Minnesota population center, University of Minnesota.

The geographic unit of analysis for all census related data was the census block group. A block group is a statistical subset of a census tract, and generally contains between 600 and 3,000 people (US Census Bureau 2012). Each block group is uniquely identified allowing it to be represented geographically with a GIS. As of 2010, Seattle had a total of 481 block groups (Figure 1). In 2000 there were 570 census block groups, and in 1990 there were 630. Due to the changing boundaries of census block groups over time, this study aggregated the 1990 and 2000 census block group data to the 2010 census block group area based on an area weighting methodology.

Three socioeconomic variables were selected for this study, based on previous research in the quality of life, environmental justice, environmental gentrification and environmental justice literature (e.g. Jensen 2008, Sieg et al., 2004 and Boone 2009). Median household income and median home value were used to represent the economic status of each census block group. The percentage of residents 25 and older with a bachelor's degree or higher was used to represent the education status of each census block group (Table 1). Racial groups were characterized based on the proportion of each census block group that was African American or Asian.

The socioeconomic census data in .csv files and census block groups in shapefile format were downloaded from the NHGIS website. The .csv files and shapefiles were imported into the ArcMap data frame using ArcGIS10.2.2. The .csv files and the shapefiles were joined together using the join function to attribute the socioeconomic and racial data for each census block group based on its unique identifying object ID number.
Table 1 Socioeconomic variables collected by the US Census Bureau (Census Bureau, 1990, 2000, 2010). These variables were used to analyze the process of socioeconomic change from 1990 – 2010.

<table>
<thead>
<tr>
<th>Socioeconomic variables</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race (Whites, Blacks, and Asians)</td>
<td>Percentage of persons belonging to a particular racial group</td>
</tr>
<tr>
<td>Median Income</td>
<td>Median household income in U.S. dollars (with inflation accounted for)</td>
</tr>
<tr>
<td>Median housing value</td>
<td>Median value of owner-occupied housing units in U.S. dollars</td>
</tr>
<tr>
<td>Educational Attainment</td>
<td>Percentage of population age 25+ with high school diploma/ equivalent or bachelor degree or higher as their highest earned degree</td>
</tr>
</tbody>
</table>

3.2. Spatial data analysis

The overall median household income, median home value, and educational attainment were calculated for the City of Seattle for 1990, 2000, and 2010 (Table 2). Each census block group was classified as above (labeled as A) or below (labeled as B) the overall city median for each of these variables in each time period. For each socioeconomic variable (education, home value, household income), the trajectory relative to above- or below-median status of each census block group was determined from 1990 to 2000 and from 2000 to 2010. There are eight possible trajectories of transition from 1990 to 2010 (Table 3).
Table 2 City of Seattle overall median for selected socioeconomic characteristics for each decennial census year (1990, 2000, and 2010).

<table>
<thead>
<tr>
<th>Socioeconomic variables</th>
<th>City of Seattle median</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1990</td>
</tr>
<tr>
<td>Median household income</td>
<td>$29,353</td>
</tr>
<tr>
<td>Median home value</td>
<td>$137,900</td>
</tr>
<tr>
<td>Educational Attainment</td>
<td>38%</td>
</tr>
</tbody>
</table>

n = number of households; n= 236,908 in 1990, n=258,635 in 2000, n=290,822 in 2010

Table 3 The transition trajectory for census block groups above or below the city median in for each census year.

<table>
<thead>
<tr>
<th>Series</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA</td>
<td>Consistently above the city median</td>
</tr>
<tr>
<td>AAB</td>
<td>Census block group above city median for two consecutive time periods then fell below</td>
</tr>
<tr>
<td>ABB</td>
<td>Above city median in t₁, and fell below and remained below for t₂, t₃</td>
</tr>
<tr>
<td>ABA</td>
<td>Above the city median in t₁, below in t₂, and rose above the city median in t₃</td>
</tr>
<tr>
<td>BBB</td>
<td>Consistently below the city median</td>
</tr>
<tr>
<td>BBA</td>
<td>Below the city median for two consecutive time periods and then rose above the median in t₃</td>
</tr>
<tr>
<td>BAA</td>
<td>Below the city median in t₁ and rose above and remained above the median in t₂, t₃</td>
</tr>
<tr>
<td>BAB</td>
<td>Below the city median in t₁, above the median in t₂, and fell below the median in t₃</td>
</tr>
</tbody>
</table>

3.3 Mapping gentrified census block groups

Seven trajectories of change were possible for a census block group in each time period (1990 to 2000, 2000 to 2010) based on three socioeconomic variables; education, home value, and income (Figure 1). A gentrified census block group was defined as having at least two socioeconomic characteristics that transitioned from below the median in t₁ to above the median in t₂. Six other trajectories were not
identified as gentrification: (1) no change, (2) an increase in one variable compensated by a decrease in another variable, (3) decrease from above to below median in two or more variables, (4) change from above median in three variables to above median in only two variables, (5) change from above-median in two variables to above-median in three variables, (6) change from below-median in three variables to below-median in two variables. These trajectories were mapped for the two periods, 1990-2000 and 2000-2010.

Figure 1. Example transition matrix showing the numbers of census block groups that experienced seven possible trajectories of change from 1990 \( (t_1) \) to 2000 \( (t_2) \) in Seattle, Washington. 3-Below (3-above) means that a census block group was below (above) the median in education, home value, and household income in that time period. 2-Above or 2-Below means that two variables were above (below) the median. Hmval = home value, Edu = educational attainment, and Inc = household income. For example, a census block group classified as 2-Above (Hmval and Edu) had median home value and educational attainment that were above the median for the City of Seattle in that period, but the median household income was below the median for all households in the City of Seattle.
3.4 Change in African American populations

The change in percentage of African Americans was calculated (percent in time 1 minus percent in time 2) for each census block group for the time periods 1990 to 2000 and 2000 to 2010. The resulting layer was overlaid on the map of gentrification for the corresponding time period.

3.5. Content analysis on select neighborhoods of gentrified census block groups

This study used a semi-structured media content analysis to identify locations of perceived gentrification from news sources and blog websites from 1990 – 2010. Content analysis is an important technique used in social sciences and communication research to infer meanings and identify characteristics within the content (Holsti 1969). The content analysis in this study was conducted to determine how and where gentrification is perceived by the media and the community and to validate the quantitative spatial analysis of census data.

Data for the content analysis were acquired through a search of the LexisNexis Academic and Google databases, available via Oregon State University Libraries and Google. The databases were searched using names of Seattle neighborhoods (ie: Central District), as well as terms related to gentrification, displacement, and affordable housing. The following search terms were used for the initial search: gentrification AND Seattle, Washington OR affordable housing, AND "Central District", OR "Ballard", OR "Capitol Hill" OR "West Seattle." All identified articles were downloaded and combined into a single word document. This generated a sample of 118 articles. Next, the articles were filtered to identify all that were related to Seattle and events related to gentrification; this reduced the sample to approximately 100 articles. Utilizing word cloud web applications and general word and phrase search methods, the content was analyzed to identify emerging patterns and themes. Instances of perceived gentrification in the articles included (1) changes in neighborhoods due to gentrification, (2) neighborhood changes based on shifting demographic, (3) other anecdotal accounts that signify social, economic, and cultural changes within and around neighborhoods. The spatial coordinates of perceived gentrification were identified by place names and street addresses mentioned in the
articles. Using Google Earth, I searched for the place names or addresses and created pin points for each place. Google saves place pin points in .kml format, which I then converted into a shapefile in ArcGIS 10.2.2.

4. Results

4.1 Changes in spatial patterns of education, home value, and household income

For educational attainment, in 1990 more than half of the census block groups were below the median, but in 2000 the census block groups were almost evenly split, and by 2010, more than half of the census block groups were above the median for educational attainment (Table 4). For home value consecutively each census year more than half of the census block groups were below the median (Table 4). For median household income, in 1990, 2000, and 2010 more than half of the census block groups were above the city median (Table 4).

Table 4 The percentage of census block groups categorized as greater than or less than the city of Seattle median for each socioeconomic characteristic by year.

| Percentage of census block groups above or below the city of Seattle median for each variable 1990 - 2010. n=481 |
|-------------------------------------------------|---|---|---|---|
| Socioeconomic Variables | 1990 | 2000 | 2010 |
|-------------|---|---|---|---|
| Educational Attainment | A | B | A | B | A | B |
| Median Home Value | 43.5 | 56.5 | 50.7 | 49.3 | 53.6 | 46.4 |
| Median Household Income | 40.3 | 59.7 | 43.0 | 57.0 | 42.8 | 57.2 |

In 1990 census block groups above the city median for household income were concentrated in north Seattle, and along the Puget Sound and Lake Washington (Figure 2-A). Most of the census block groups below the city median for household income were found in south Seattle. This trend continued into 2000 and 2010 (Figure 2-B and C). Forty-two percent of census block groups were above the median in 1990, 2000, and 2010 (AAA); these were located along the Puget Sound and Lake Washington. Census block groups that were below the median in all three time
periods (BBB) made up 29 percent of the census block groups and were clustered in South Seattle and in North Seattle (Table 5-A and Figure 5-A).

In 1990, census block groups that were above the city median for home value were mostly found along the Puget Sound and Lake Washington areas. This pattern was fairly consistent for each census year observed (Figure 3). Census block groups that were above the median in all three time periods (AAA) made up 28.9 percent of the census block groups. They were found in large clusters along the Puget Sound and Lake Washington areas as well as inland in North Seattle near Green Lake and Lake Union (Figure 5-B). Census block groups categorized as BBB made up 43.2 percent of the census block groups (Table 5-B). Large clusters of census block groups below the median in all three time periods (BBB) were found in both north and south Seattle (Figure 5-B).

Educational attainment had a steady increase in the percentage of census block groups that were above the city median from 1990 to 2010 (Table 4). However, this increase is mostly found in the northern sections of the city whereas most of south Seattle remained below the city median from 1990 to 2010 (Figure 4). Thirty-six percent of census block groups were above the median in all three time periods (AAA), and these were located in north Seattle specifically toward the east side of the city with some clustering along the north end of the city along the Puget Sound. Census block groups categorized as BBB made up 37 percent of the census block groups and were found in large clusters in South Seattle, and one large cluster in North West Seattle. There also appears to be a contagion effect of clusters of census block groups categorized as BBA and BAA that are adjacent to BBB census block groups in both North and south Seattle (Figure 5-C).
Table 5 The percentage of census block groups belonging to each transition for each socioeconomic characteristic from 1990 to 2010.

<table>
<thead>
<tr>
<th>Series</th>
<th>No. of census block groups</th>
<th>Percentage of Census block groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA</td>
<td>202</td>
<td>42.0</td>
</tr>
<tr>
<td>AAB</td>
<td>36</td>
<td>7.5</td>
</tr>
<tr>
<td>ABA</td>
<td>18</td>
<td>3.7</td>
</tr>
<tr>
<td>ABB</td>
<td>15</td>
<td>3.1</td>
</tr>
<tr>
<td>BAA</td>
<td>19</td>
<td>4.0</td>
</tr>
<tr>
<td>BAB</td>
<td>19</td>
<td>4.0</td>
</tr>
<tr>
<td>BBA</td>
<td>28</td>
<td>5.8</td>
</tr>
<tr>
<td>BBB</td>
<td>144</td>
<td>29.9</td>
</tr>
</tbody>
</table>

Transition Matrix for Median Household Income 1990 - 2010. (n=481)

<table>
<thead>
<tr>
<th>Series</th>
<th>No. of census block groups</th>
<th>Percentage of Census block groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA</td>
<td>139</td>
<td>28.9</td>
</tr>
<tr>
<td>AAB</td>
<td>25</td>
<td>5.2</td>
</tr>
<tr>
<td>ABA</td>
<td>13</td>
<td>2.7</td>
</tr>
<tr>
<td>ABB</td>
<td>17</td>
<td>3.5</td>
</tr>
<tr>
<td>BAA</td>
<td>18</td>
<td>3.7</td>
</tr>
<tr>
<td>BAB</td>
<td>25</td>
<td>5.2</td>
</tr>
<tr>
<td>BBA</td>
<td>36</td>
<td>7.5</td>
</tr>
<tr>
<td>BBB</td>
<td>208</td>
<td>43.2</td>
</tr>
</tbody>
</table>

Transition Matrix for Median Home Value 1990 - 2010. (n=481)

<table>
<thead>
<tr>
<th>Series</th>
<th>No. of census block groups</th>
<th>Percentage of Census block groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA</td>
<td>172</td>
<td>35.8</td>
</tr>
<tr>
<td>AAB</td>
<td>15</td>
<td>3.1</td>
</tr>
<tr>
<td>ABA</td>
<td>14</td>
<td>2.9</td>
</tr>
<tr>
<td>ABB</td>
<td>8</td>
<td>1.7</td>
</tr>
<tr>
<td>BAA</td>
<td>35</td>
<td>7.3</td>
</tr>
<tr>
<td>BAB</td>
<td>22</td>
<td>4.6</td>
</tr>
<tr>
<td>BBA</td>
<td>37</td>
<td>7.7</td>
</tr>
<tr>
<td>BBB</td>
<td>178</td>
<td>37.0</td>
</tr>
</tbody>
</table>

Transition Matrix for Educational Attainment 1990 - 2010. (n=481)
Figure 2 The spatial distribution of census block groups categorized as being greater than or less than or equal to the city of Seattle median for median household income from 1990 – 2010.
Figure 3 The spatial distribution of census block groups categorized as being greater than or less than or equal to the city of Seattle median for median home value from 1990 – 2010.
Figure 4 The spatial distribution of census block groups categorized as being greater than or less than or equal to the city of Seattle median for educational attainment from 1990 – 2010.
Figure 5. The graphical representation of the transition matrix showing the locations of each census block group above or below the city median for each socioeconomic category from 1990 to 2010.
4.2 Spatial patterns of socioeconomic change and gentrification, 1990 to 2000

The analysis of trajectories of change in three socioeconomic variables (education, home value, and income) reveals complicated spatial patterns in Seattle from 1990 to 2000 (Figure 6) and 2000 to 2010 (Figure 7).

From 1990 to 2000, 9% of all the census block groups gentrified, based on an increase from below to above-median in two or more socioeconomic variables: education, home value, and household income. This pattern appears to be clustered, and most census block groups that gentrified during this time period appeared to be adjacent to at least two other gentrified census block groups. The clustered pattern is most apparent in Northwest Seattle, among the Ballard and Freemont neighborhoods. Other clusters of gentrified census block groups were located in the Capitol Hill, Downtown, and West Seattle neighborhoods (Figure 6).

Overall, 61.3% of census block groups had no change and were evenly dispersed throughout the city. Census block groups that were below the median in all three categories in 1990 and remained below the median in all three categories in 2000 were located in both North and South Seattle, with the majority of occurrences in South Seattle (areas labeled BBB in Figure 6). Census block groups that were above the median in all three categories from 1990 to 2000 were concentrated in North Seattle along the Puget Sound and Lake Washington, and inland in Magnolia, Queen Anne, and Capitol Hill neighborhoods (areas labeled AAA in Figure 6).

Census block groups that increased in one category and were compensated by a decrease in another category made up 2.5% of all census block groups. They were found mostly in North Seattle and bordered (on at least two sides) a census block group that experienced no change. Six percent of the census block groups improved from above median in two categories to above median in all three categories and these occurred mostly in north and West Seattle. Eight percent of the census block groups had an improvement from below median in three categories to below median in only two categories. Three percent of the census block groups were above median in all three categories and transitioned to above median in only two of three categories. Lastly, 10% of census block groups showed deterioration from above median to below median in two or more categories. Clusters of deteriorating census
block groups were found in north Seattle, downtown and Southeast and southwest Seattle (Figure 6). From 1990 to 2000, fifteen census block groups that gentrified had above-median income in 1990. Eleven census block groups remained above the median for income in 1990 and 2000 and transitioned to above the median in educational attainment by 2000. Most of these census block groups were located in North Seattle, but three were in West Seattle, and one was in the Rainier Valley, Mount Baker neighborhood. Three of the fifteen census block groups that led the socioeconomic transition with above-median income transitioned to above-median home value in 2000. These census block groups were located in North Seattle in the Freemont neighborhood, Central Area, and West Seattle’s North Admiral neighborhood. The remaining census block group that led with high income in 1990 transitioned to above-median home value and educational attainment but income fell below the median in 2000. This census block group was located in North Seattle in the Sand Point neighborhood. From 1990 to 2000 fifteen census block groups that gentrified had educational attainment above the median in 1990. Ten of these census block groups remained above the median for educational attainment and transitioned to above-median home value in 2000 and most were located in North Seattle’s Freemont, Wallingford and the University District neighborhoods, while others were located in the Capitol Hill neighborhood. Two of the fourteen census block groups remained above the median for educational attainment and transitioned to above-median income in 2000; these census block groups were located in the Phinney Ridge and University District neighborhoods. Another two census block groups transitioned to below-median in educational attainment and above-median in home value and income from 1990 to 2000; these census block groups were located in Downtown Seattle. The remaining census block group located in Northeast Seattle in the Roosevelt neighborhood transitioned all three categories above the median. Only two of all gentrified census block groups was above-median home value in 1990. In 2000 both census block groups remained above the median for home value and transitioned to above-median educational attainment. The census block groups were in Ballard and Downtown neighborhoods.
Figure 6 The spatial distribution of socioeconomic change and gentrification in Seattle from 1990 – 2000. (n=481)
4.3 Spatial patterns of socioeconomic change and gentrification, 2000 to 2010

From 2000 to 2010, 9% of all census block groups gentrified. Gentrification was concentrated mostly in North Seattle in the Lake City, Northgate, Bitter Lake, Broadview and Crown Hill neighborhoods. Other clusters of gentrified census block groups were apparent in the Central Area, Lower Queen Anne, Lake Union and Belltown neighborhoods (Figure 7).

From 2000 – 2010, 53.2% of census block groups experienced no change. Census block groups that were below the median for all three socioeconomic variables in 2000 and 2010 were concentrated in southeast Seattle within the Beacon Hill neighborhood (BBB in Figure 7). Census block groups that were above the median for all three socioeconomic variables in 2000 and 2010 were concentrated along the Lake Washington and Puget Sound coastlines and inland in Capitol Hill, Queen Anne, Magnolia, Wallingford, Green Lake, Ravenna, and Bryant neighborhoods (AAA in Figure 7).

Census block groups that increased in one category and were compensated by a decrease in another category made up 4.2% of the census block groups. Census block groups that improved from above the median in two categories to above the median in all three categories made up 4.8% of the total and were found mostly in North Seattle with some clustering in West Seattle. Census block groups that improved from below-median in three categories to below median in two categories made up 7.7% of the total and were evenly dispersed throughout North and South Seattle. Census block groups that experienced a small decline in socioeconomic status mostly occurred in North and West Seattle. Census block groups that declined in socioeconomic status from 2000 to 2010 made up 15.4% of the total and were located in both North and South Seattle (Figure 7).
Figure 7 The spatial distribution of socioeconomic change and gentrification from 2000 to 2010.
From 2000 to 2010, thirteen census block groups that gentrified were above the median for household income in 2000. Of these, nine census block groups remained above the median for income and transitioned to above-median educational attainment by 2010. Six of these census block groups were located in North Seattle’s Ballard, Bitter Lake, Northgate and Lake City neighborhoods, and three were located in West Seattle’s Fairmount Park and Gatewood neighborhoods. Three census block groups remained above the median for household income and transitioned to above-median for home value by 2010; these were located in North Seattle, Central Area, and the Industrial District neighborhoods. One census block group transitioned to above-median home value and education, but to below-median income in 2010; this census block group was located in West Seattle’s North Admiral neighborhood.

Two census block groups that gentrified from 2000 to 2010 had above-median home value in 2000. These census block groups remained above the median for home value and transitioned to above-median educational attainment in 2010; they were located in Capitol Hill and West Seattle.

Eight census block groups that gentrified from 2000 to 2010 had above-median educational attainment in 2000. Five of these transitioned to above-median income by 2010. They were located in North Seattle’s Greenwood, Wedgewood and Queen Anne neighborhoods. The remaining three census block groups transitioned to above-median home value by 2010; they were located in the Queen Anne, Central Area, and Fremont neighborhoods.

4.4 Racial changes in gentrified census block groups, 1990 – 2000

From 1990 to 2000, gentrified census block groups with high proportions of African American or Asian populations were negatively affected by the changes occurring the their neighborhoods. In 1990, high proportions of African Americans were found in Central Area and Rainier Valley neighborhoods. In 1990 census block groups G53003300088001 and G53003300089002 African Americans made up 74.9 and 56.1% of the population, but the percentages dropped to 44.1 and 42.7% by 2000, coinciding with gentrification of these census block groups (Figure 8). In the Rainier Valley, census block group G53003300101005 also gentrified, and the African
American population declined from 42.6% to 27.6% of the population from 1990 to 2000 (Figure 9). The Asian population within this census block group also decreased from 18.4% in 1990 to 16.4% in 2000. Census block groups with low percentages of Asian populations that gentrified did not experience significant changes in Asian populations; most had 1-2 percentage point increases in Asian populations.

Figure 8 Change in the African American racial composition in the Central Area from 1990 to 2000.
Figure 9 Change in the African American racial composition in the Rainier Valley from 1990 to 2000.

From 1990 to 2000, census block group # G53003300053022, located in the University District, gentrified. Over the same period Asians declined from 43.5% to only 7.7% of the total population, African Americans decreased from 5.1% to 2.5%, and Whites increased from 42 to 79.8% of the population in this census block group (Figure 10). In census block group G53003300044004, which gentrified from 1990 to 2000, Asians increased from 13.3 to 18.3% of the population while African Americans decreased from 3.5 to 2.0% (Figure 6).
Figure 10 Change in racial composition of the Asian racial group in the University District from 1990 to 2000.

4.5 Racial changes in gentrified census block groups, 2000-2010

The most drastic declines in African American population occurred in five gentrified census block groups located in the Central Area neighborhood in Seattle. From 2000 to 2010 African Americans decreased from 45% to only 5% of the population of census block group # G53003300079001 and from 26.7% to only 3% of the population of census block group #G53003300077004 (Figure 11). The remaining census block groups that gentrified in the Central Area neighborhood also had decreases in the African American population, but the declines were smaller (declines of -5.8, -6.1, and -8.5 percentage points for census block group #’s...
G53003300087002, G53003300077001, and G53003300087001, respectively) (Figure 11).

Two of the five census block groups (census block groups G53003300079001 and G5330003300077004) in the Central Area experienced the greatest declines in African American populations in the city over this period. Census block group G53003300079001 was below the median for all three socioeconomic characteristics in 2000, but by 2010 it transitioned to above the median for educational attainment and home value. Census block group G5330003300077004 was above the median for educational attainment in 2000, and it transitioned to above the median for home value and income, while educational attainment fell below the median by 2010.

Figure 11 Change in the African American racial composition in gentrified census block groups in the Central Area from 2000 to 2010.
Seven census block groups that gentrified from 2000-2010 had positive changes in their African American populations. From 2000 to 2010 African Americans increased from 4% to 16% of the population of gentrified census block group #G5300330094004 in the Beacon Hill neighborhood (Figure 12-D). Four census block groups that gentrified in West Seattle also experienced an increase in the African American population. From 2000 to 2010, the African American population increased from 4.1% to 9.0% in census block group # G53003300105002; from 2.2% to 7.7% in census block group # G53003300096002; and from 2.2% to 5.7% in census block group # G53003300097023 (Figure 12-C). Two census block groups in North Seattle had positive changes in African American populations from 2000 to 2010. African Americans increased from 4.1% to 13.5% in census block group# G53003300017013, located in the Greenwood neighborhood (Figure 12-A) and from 2.7% to 8.0% in census block group # G5300330021002, which covers parts of the Meadowbrook and Wedgewood neighborhoods (Figure 12-B).
Gentrification trajectories varied for the census block groups that experienced increases in their African American populations. Three census block groups that gentrified in southwest Seattle led the transition with income above the Seattle median in 2000 and experienced an increase in educational attainment above the median by 2010. The census block groups that gentrified in north Seattle led with above-median educational attainment in 2000 and followed with a transition to above-median income by 2010. The census block group that experienced the greatest positive change in the percentage of African Americans in Seattle in this period also had the most significant gentrifying transition. This census block group (#G53003300094004), located in the Beacon Hill neighborhood, was below the median in all three categories in 2000 and transitioned to have all three categories above the median in 2010 (Figure 12-D).
Asian populations decreased in 27 of the 43 census block groups that gentrified. Decreasing values ranged from -49% to -0.27%, with the majority of gentrified census block groups ranging from -9% to 0% change in Asian population. In some cases, when Asian populations decreased, African American populations increased in census block groups that gentrified. This trend was most pronounced in census block group # G53003300094004, located in the Beacon Hill neighborhood. From 2000 to 2010, Asian population decreased in this census block group from 61 percent to 12 percent of the population (Figure 13-B); this is the census block group in which African Americans increased dramatically over the same period (Figure 12-D).

One other gentrified census block groups with a high percentages of Asian population loss was located in North Seattle in Northgate neighborhood. This census block group declined from 11.6 percent in 2000 to 1.5 percent in 2010. (Figure 13-A).

Figure 13 Spatial distribution of the greatest negative change in Asian racial groups within gentrified census block groups from 2000 – 2010.
From 2000 to 2010, nine gentrified census block groups had a positive change between 1 percent and 10 percent, they were located in North Seattle, Downtown, Central Area and Capitol Hill and West Seattle neighborhoods. Of all the gentrified census block groups two census block groups located in the Downtown and Cascade neighborhoods had the greatest positive change. Census block group #G53003300080015 located in the Downtown neighborhood increased. This census block group was below the median for all three characteristics in 2000, by 2010 educational attainment and income were above the median. Census block group #G53003300073003 increased from 10 percent to 21 percent from 2000 to 2010 (Figure 10). The census block group was below the median for all three characteristics in 2000; by 2010 educational attainment and income were above the median.

Figure 14 Greatest positive change in Asian population in a gentrified census block group in the Downtown and Cascade neighborhoods, Seattle, from 2000 to 2010.
4.6. Relationship of racial change to gentrification

From 1990 to 2000, African American racial change varied across Seattle. In 1990, the highest percentages of African Americans (>50%) were located in the Central Area just east of downtown Seattle, and high percentages of African Americans were also found in South Seattle (Figure 15). From 1990 to 2000, African American populations both increased and decreased as a proportion of census block group populations. The greatest decline (of 15 to 34 percentage points) occurred in a spatially clustered pattern in central Seattle. African Americans also declined in south Seattle by 5 to 14 percentage points, with some areas experiencing declines of more than 24 percentage points. Over the same period, African American populations increased by more than 2 percentage points, and in some cases more than 11 percentage points, in the most northern, southwestern, and southern portions of Seattle.

From 2000 to 2010, declines in African American population were more widespread throughout Seattle than in 1990 to 2000. As in 1990 to 2000, the greatest declines (of up to 40 percentage points) occurred in central Seattle. African Americans continued to increase as a percent of total population in northern Seattle. In southwest Seattle, African American population decreased slightly in areas where it had increased in the previous decade. In south Seattle, the African American population increased in some areas where it had decreased in the previous decade.

Gentrified census block groups appear to be clustered in north, central, and southwest Seattle in both periods (1990 to 2000 and 2000 to 2010). Census block groups that experienced gentrification from 2000 to 2010 were adjacent to census block groups that gentrified in the previous time period, 1990 – 2000 (Figure 2 and 3).

Gentrified census block groups were associated with both declining and increasing African American populations, but the relationships between gentrification and changes in African American populations differ among central, northern, southern, and southwestern Seattle. From 1990 to 2000, gentrification was associated with declining African American populations in central Seattle (A-1 in Figure 13) and in one census block group in south Seattle (B-1 in Figure 13). Two gentrified census
block groups in north and west Seattle had increases in their African American populations, while the rest experienced no change in African American populations (Figure 16A). From 2000 to 2010, African American populations declined in gentrified census block groups in central Seattle and north Seattle (Figure 16 B). In central and north Seattle, some of the census block groups that had experienced increased African American population from 1990 to 2000 gentrified and lost African American populations from 2000 to 2010. Small increases in African American populations were associated with gentrification in census block groups in southwest Seattle.

In some cases, gentrification preceded the decline in African American populations. In census block groups that gentrified from 1990 to 2000, located just west of the Central Area in Capitol Hill (Box A-1, Figure 13), the African American population decreased slowly in 1990 to 2000, but more rapidly in the following decade.

In other cases, including much of central Seattle, changes in African American population preceded gentrification. In central Seattle, African American populations declined from 1990 to 2000 in census block groups which did not fit the definition of gentrification in 1990 to 2000, but which became gentrified in 2000 to 2010. For example, African American population declined by 15 to 24 percentage points in a census block group located in the Lower Queen Anne area from 1990 to 2000. In 2000 to 2010, this census block group gentrified, and the African American population continued to decline (Figure 13, Box A-1 and A-2).
Figure 15 - Percent African Americans in 1990
Figure 16. Gentrified and declining census block groups, change in percentage of African American residents within each census block group, and places where gentrification was perceived (a) from 1990 – 2000 and (b) 2000 – 2010. Census block groups designated as “gentrified” experienced a change from below to above-median status in two or more of three categories: education, income, and home value over the period. Census block groups designated as declining experienced a change from above to below-median status in two or more of three categories: education, income, and home value over the period.

4.7. Within-neighborhood spatial and temporal patterns of gentrification and racial change

A closer look at three selected areas in Seattle reveals the complexity and multidimensional aspect of gentrification, with contrasting patterns in different areas (Figure 17). In central eastern Seattle, six census block groups gentrified from 1990 to 2000, and African American populations declined in two of these (Box A-1, Figure 17). From 1990 to 2000 in central Seattle, seven census block groups fell behind in
terms of education, home value, and income, and African American populations declined in three of these. African American population also declined, and gentrification was perceived, in many census block groups where gentrification was not identified based on changes in education, home value, and income (Box A-1, Figure 17). In central eastern Seattle from 2000 to 2010, nine census block groups gentrified, and African American populations declined in eight of these (Box A-2, Figure 17). Over the same period, nine census block groups had declining levels of education, home value, and income, and African American populations increased in four of these.

An area in northwestern Seattle experienced contrasting patterns from those in central Seattle (Boxes B-1 and B-2, Figure 17). In this area, ten census block groups gentrified in terms of education, income, and home value from 1990 to 2000, but did not experience declines in African Americans. Asian populations both increased and decreased in these areas (Figures 16 and 17). Interestingly, from 1990 to 2000 the percent of African American population increased in one census block group whose neighboring census block groups experienced gentrification and little to no change in their African American populations over the same period (Box B-1, Figure 17). In the following decade, this census block group gentrified, and the African American population declined (Box B-2). In general, percentages of African American populations did not change in this area from 1990 to 2000, but they began to decline in 2000 to 2010 (Box B-1 and B-2, Figure 17).

Patterns of change in southern Seattle differed from those in central or northern Seattle over the study period (Boxes C-1 and C-2, Figure 17). In the upper half of the Rainier Valley and Beacon Hill (Box C-1, Figure 17), one census block group gentrified from 1990 to 2000 and African American percentages declined sharply. Five census block groups fell behind in terms of education, home value, and income, and African American percentages declined in two of these. African American percentages also declined in a number of census block groups, and gentrification was perceived, but gentrification (in terms of education, home value,
and income) was not detected. From 2000 to 2010, African American populations increased in some census block groups, and decreased in others. One census block group in the Beacon Hill area gentrified and experienced a large increase in African American population (Figure 17, Box C-1 and C-2).

Figure 17. Expanded views of selected areas shown in Figure 16.

4.8 Content analysis on select neighborhoods of gentrified census block groups 1990 - 2010

The results of the content analysis on gentrifying neighborhoods revealed a pattern of news sources and blogs about gentrification and its effects on communities within Seattle. Media reports and blogs primarily discussed a few neighborhoods: Central Area, Capitol Hill, Columbia City, and Mount Baker in the Rainier Valley,
Beacon Hill, and Belltown. Three major themes emerged from the analysis: shifts in demographics, a sense of community (or lack thereof in some cases), and economic and development booms.

4.8.1. Demographic Shifts

A number of articles and blogs reported that communities experiencing gentrification were also experiencing major shifts in racial demographics. The Central Area (also known as the Central District) experienced gentrification and declining minority population from 1990 to 2010 (Figure 17). Content analysis showed that gentrification in these census block groups has changed the lives of people in the neighborhood. For example the Seattle Times reported, “[the] Central Area is now home to fewer African Americans than at any time in the past 30 years” (Seattle Times 2001, July 22). The Stranger reported that the Central Area’s improved economic conditions are linked to “large movement[s] of Blacks out of the neighborhood.” However, the movement of Blacks is not always due to outright displacement. The pastor of Mt. Zion, Central District’s oldest Black church, wrote, “some black families are moving out of the traditionally black Central District to posher areas like Kirkland, Newport Hills, and Mercer Island; [whereas], “poorer blacks – victims of rising property taxes and ballooning housing prices – are being forced out of Seattle” (Campell 2000).

Some view the change occurring in the Central District as favorable, while others see it as “fundamentally destroying the cultural heritage of the city” (Richards 2015). A longtime resident and one of the Central District’s black business owners, Earl Lancaster, who owns the historically black barbershop, Earl’s Cuts and Styles, perceived positive elements of the change. Lancaster recently hired a Caucasian barber due to the change in the color of the neighborhood. Lancaster says, “The community is getting more diverse …[and] I wanted to reflect that. It’s not just a black barbershop. It’s a men’s grooming place.” A patron of the barbershop and longtime resident of the Central District disagreed, indicating that he, “liked [the] neighborhood the way it used to be” (Hansen 2013).
Gentrification is also occasionally linked to violence in media reports. For example, in 2001, longtime activist James C. Garrett attacked the Mayor of Seattle. Residents of the areas reported that “Garrett’s act was fueled by a growing well of frustration that stems from issues ranging from accountability to crime in the neighborhood, to issues of gentrification” (Jamieson, Murakami, and Rutherford 2001).

Changing demographics also were linked to violent acts in Capitol Hill, a neighborhood located just north of the Central Area. A number of census block groups in this area gentrified from 1990 to 2010, and cultures have clashed. Capitol Hill was at one time dominated by predominantly gay households. Gentrification brought a differing sexual orientation of its newcomers, and tensions have risen between young straight people and gay people. The Seattle Times reported that a young transgender man walking home from a club was verbally and physically attacked by two straight men (Romano 2015). Another news article highlights an anti-gay arsonist who endangered nearly 750 people at a gay nightclub on New Year’s Eve in 2014 (Pulkkinen 2014). These events have spurred the mayor of Seattle to implement a task force aimed at investigating methods of improving safety in the Capitol Hill neighborhood (Garner 2015).

4.8.2. Sense of Community (or lack thereof)

The idea of community and building networks between old and new residents was a reoccurring theme in the news and neighborhood blogs. In Beacon Hill, “When new businesses move, they often don’t try to understand the people who are here, their way of communicating and acting toward one another,” says Khazm, [whose] family has lived in Beacon Hill for generations. “They aren’t focused on building communities, their interested in investing in property” (Uitti 2015).

The process of gentrification also has affected the sense of community and belonging in the Central District. The Union Street Business Association noted that as a result of gentrification, the Central District has “lost a sense of belonging, a sense
of safety, and a sense of ownership” (Jones 2015). One person remarked, “I thought I would never see the time when I am driving through and white folks would look at me strangely. I’m like, ‘I grew up in this area, what are you looking at me for?’” (Pisacane 2015). The struggle to integrate the cultures of longtime residents and newcomers affects many neighborhoods experiencing gentrification.

4.8.3. Economic and development booms

The economic prosperity and increased development occurring in gentrified neighborhoods has direct negative effects on longtime residents. In 2014, tenants on the verge of eviction in the Ballard neighborhood picketed to protest a planned renovation that would raise rents from approximately $890/month to $1500/month in the Lockhaven apartment complex (Sears, K. 2014). The Freemont neighborhood has also experienced an economic boom since the 1990s, with new coffee shops and high-priced townhouses in the commercial core. One resident commented, “We now have more espresso bars than antique stores” (Freeman, P. 1999). In the Central District an article noted that development of condominiums and triplexes along 23rd Avenue and Rainier Avenue have raised rents and taxes to levels that prior residents cannot afford (Mudede, C. 2005).

5. Discussion

Displaying gentrified census block groups overlaid on racial change and perceptions of gentrification suggests that dynamic processes are at work in Seattle. Gentrification is not binary, but exists on a spectrum, with many states and forms, and it affects people and places differently. The initial definition of gentrification in this study was based only on changes in education, income, and home value. The addition of other information, such as changes in minority population and perceptions of gentrification, provided a more nuanced picture of change in Seattle. For example, from 1990 to 2000, gentrification coincided with declines in the African American population and with accounts of perceived gentrification in some areas. However, gentrification also was reported in areas that did not fit the definition of gentrification in terms of change in education, income, and home value, but had declines in African
American populations and were near census block groups that did gentrify based on this definition. Moreover, areas that experienced changes in education, income, and home value, but lacked racial change, were also perceived as gentrifying based on media accounts. These findings demonstrate that gentrification is a multi-dimensional, spatially contagious, dynamic process.

This analysis also reveals that the effects of gentrification do not always lead to displacement of minorities. In some cases, African American populations slightly increased in census block groups that gentrified. This may suggest that some African Americans are able to take part in the process of gentrification and are exercising a type of upward mobility. In other cases, census block groups declined in terms of education, home values, and income, and also had increases in the African American population. This may indicate migration of African Americans from some areas to other areas, where they may take advantage of declining home values and rents. The same processes may be affecting Asian populations.

The relationship of gentrification to change in minority population was related to the density or concentration of minority residents. Outside of Seattle’s historically black neighborhood, the Central Area, gentrification appeared to precede declines in African Americans. However, within the Central Area and adjacent neighborhoods where clusters of higher proportions of African Americans reside, gentrification appeared to both precede and follow gentrification.

5.1. Hypothesis 1: Gentrification is more likely in neighborhoods with relatively low income, home value, and education, as well as high proportions of minorities.

We expected to find more frequent gentrification in census block groups that were below the median for educational attainment, home value and income at the beginning of the study. Instead, household income was above the median at the beginning of the study in many (44 percent) census block groups that gentrified, although home value and educational attainment were below the median. This was a surprising finding, because census block groups below the median in all three categories have been thought to be more vulnerable to gentrification. The process of gentrification happens gradually, and as we found, can reverse direction. Results of
this study support the interpretation that census block groups that were below the median with respect to income, home value, and education experienced incremental transitions over several decades, in which one socioeconomic variable increased first, followed by increases in the others. Thus, a transition from below the median for all three socioeconomic variables, to above the median for one of these, may be an early indicator of gentrification (Figure 6 and 7). In most census block groups that gentrified, household income transitioned to above the median first, followed by increases in education and home value; this suggests that increased income promotes upward mobility in terms of educational achievement and ability to take part in home ownership.

5.2. Hypothesis 2: Gentrification is more likely to occur in locations adjacent to areas that gentrified in a previous time period.

We expected census block groups to gentrify in a clustered pattern throughout South Seattle. We found that gentrification was clustered among census block groups in West Seattle and in North Seattle. Prior studies have also found clustering of gentrification in Seattle in these areas (White 2012). Clustered patterns of gentrification may be related to Tobler’s first law, that everything is related, but things closer together are more related. An area may gentrify because of spillover from neighboring wealthier census block groups. From 1990 to 2000, isolated census block groups that gentrified were often adjacent to census block groups that were above the city median for education, home value, and income. This process of gentrification may be related to Smith’s (1979, 1982) rent gap theory. According to the rent gap theory, gentrification will occur when existing buildings in an area have depreciated to the point that the capitalized rent is less than the potential rent for the building’s highest and best use (Smith 1979). The rent gap theory, which was proposed at the household scale, may apply at the census block group level in this study. For this study, when a neighborhood depreciated (fell below the median) so that rents were very low, the disinvestment may have created circumstances for reinvestment that was extremely profitable, leading to gentrification.
Other factors, both internal and external, may have contributed to the clustered pattern of gentrification. Internal factors might include political, economic, or occupational forces in the particular census block group. For example, in some areas, a greater number of building permits may be issued. Or, neighborhoods may have higher levels of community organization to promote development. Regarding the occupational forces, technology companies have played a big role in Seattle (ie: Adobe in Freemont and Amazon in Beacon Hill and while Microsoft is not located in a particular neighborhood it sends charter busses to the Capitol Hill and other neighborhoods to shuttle its employees to work. Intrinsic environmental factors also could lead to the area being a hotspot for new investment. For example, property values increase with proximity to environmental amenities such as parks or water bodies (e.g Figure 3). Moreover, enhancements in environmental amenities may lead to unintentional increases in property value (Aygeman 2001). Environmental gentrification is the process of investment in the natural and built environment that leads to increased property values and rents, and often leads to displacement of low-income residents (Banzhaf and Walsh 2004). This topic is addressed in Chapter 4.

5.3. Hypothesis 3: Increases in income, home value, and education coincide with declines in proportions of minorities.

We expected percentages of minorities to significantly decrease when census block groups gentrified. As expected, proportions of African American and Asian populations declined in gentrified census block groups, especially those that had high proportions of these minorities at the beginning of the study.

Decreases in African Americans that coincided with gentrification were most striking in the Central Area, but may have been driven by historical factors beyond the scope of this study. The Central District is Seattle’s oldest Black neighborhood, with low income, home values, and educational attainment. The history of the Central Area (also known as the Central District) dates back to the creation of the Federal Housing Administration, established in 1934, and the post-World War II housing boom. The Federal Housing Administration was established to encourage home ownership within the middle-class. However, racist covenants and a practice
called "redlining" prohibited Blacks, Asians and Jews from obtaining loans to purchase homes in certain neighborhoods after World War II (Jackson, 1985). In 2006, University of Washington students made public the contents of 126 residential neighborhood "covenants" affecting thousands of properties throughout Seattle that were intended to exclude blacks and other minorities from purchasing homes in certain neighborhoods. For instance, several neighborhood covenants explicitly stated that, “No Hebrew or…any person of the Ethiopian, Malay, or any Asiatic Race," or “No person of African, Japanese, Chinese, or of any other Mongolian descent” should occupy homes within the neighborhood (Piscacane 2015). The practice of redlining forced Blacks and some Asians to reside in the Central District. This history is important because it reveals that gentrification is responding to factors that have occurred over many decades prior to the period of this study (1990 to 2010).

5.4. 

Hypothesis 4: Media accounts perceive gentrification in places that experience declines in populations of minorities, but not in places that only experience changes in education, home value, and income.

We expected that the media content analysis would corroborate the quantitative spatial analysis of gentrification. Many gentrified census block groups identified by quantitative analysis also were discussed in media articles about gentrification. However, there was an overwhelming amount of coverage of the Central District and Capitol Hill, but not much about north and west Seattle. Moreover, perceptions of gentrification were also found in areas that were not identified as being gentrified in terms of education, income and home value.

5.5. Methodological issues

There are many approaches to defining and examining gentrification. This study defined gentrification across the entire landscape of the City of Seattle, based on decadal-scale changes in education, income, and home value in census block groups. This approach was designed to reveal how changes in socioeconomic variables were related to changes in minorities and how changes in neighborhoods were described in the media. Other forms of data not used in this study also could help to describe
gentrification and reveal its causes and consequences. For example, data that depicts changes in commercial activity within census block groups may reveal dramatic changes that may be related to gentrification. Changes in the built environment also are integral to the process of gentrification (Hwang and Sampson 2014).

The content analysis in this study could be expanded to include other forms of media, such as videos and photographs, to explore how gentrification is portrayed among neighborhoods. A content analysis also could be enhanced by interviews with longtime residents, newcomers, and community activists and leaders within select neighborhoods.

6. Conclusion

This study examined gentrification in Seattle at the landscape scale over two decades, using quantitative analysis of census data on education, home value, income, and race, as well as qualitative analysis of media content. Overall, the results of this study indicate that gentrification is a dynamic, spatially variable process. When gentrification was defined in terms of change in education, home value, and incomes, it often coincided with declines in minority populations and perceptions of gentrification in the media. However, in some cases gentrification defined in terms of changes in education, home value, and income was associated with modest increases in African American populations. The process of gentrification also played out gradually over time: people may perceive gentrification, or African-American populations may change, before an area experiences changes in education, home value, and income.

More work is needed to understand the causes of gentrification. This chapter showed that other factors besides those examined in this study may influence gentrification. Chapter 2 showed that park access is related to socioeconomic variables. Therefore, Chapter 4 explores how gentrification is related to changes in environmental amenities.
7. Literature Cited


Chapter 4: 
Gentrification and changes in park access and investment in Seattle, 1990 to 2010

Abstract
This study examined the relationships between spatial patterns of change and investment in urban parks and processes of gentrification over time in Seattle, Washington. A spatial analysis was conducted using GIS to test relationships between changes in socioeconomic characteristics and changes in parks from 1990 to 2010. Changes in access to three different park types (recreation, natural passive, and multiuse natural) were compared to changes in socioeconomic characteristics from 1990 to 2000 and 2000 to 2010. Spatial data on community-initiated investment in parks were also compared to spatial patterns of change in park access and socioeconomic characteristics. Gentrification was associated with locations where the number and acreage of recreational and natural passive parks increased from 1990 to 2000, and where high levels of park investment ($500,000 to $1,000,000 per census block group) had occurred from 2000 to 2010. Hence, changes in park access and investment parks influenced the character of neighborhoods over time. However, moderate and low levels of park investment were less associated with gentrification. These findings contribute to understanding of resilience of neighborhoods and to urban planning, because they indicate that there are thresholds of investment in park improvement that may increase the likelihood of environmental gentrification, or help a neighborhood to avoid environmental gentrification.

Keywords: GIS, parks, gentrification, environmental gentrification, community investment
1. Introduction and Research Questions

Striking relationships between natural and built amenities and community development have led researchers to investigate the intersections of race, environmental quality, quality of life and the migration of residents. Because environmental amenities such as parks can have positive effects on the quality of life for urban residents, research has focused on the how these amenities can lead to unequal distribution of their benefits through population displacement processes such as gentrification or environmental gentrification.

Environmental gentrification occurs when environmental policies aimed to improve quality of life primarily benefit higher income households (Sieg et al. 2004). Improvements in environmental quality may initiate the process of environmental gentrification, whereby high income people move in to a neighborhood with perceived increasing environmental amenities, and property values and rents increase. These changes may force poorer people to move to areas with lower environmental amenities, where housing values are low (Banzhaf and McMormick, 2007). Environmental gentrification has been shown to disproportionately affect minorities. Revitalization of brownfields led to the decrease in Black and Latino populations in various EPA classified regions across the U.S. (Essoka 2010). Case studies in Vancouver and Toronto showed an inverse relationship between the investment in greenery and the affordability of homes in the neighborhood (Dale and Newman 2009). Hence, investment in parks, or expansion of parks, may lead to environmental gentrification.

This study took advantage of spatially and temporally explicit data on park types, park investment and demographic data to test how the process of gentrification was related to changes in environmental amenities, focusing on the park system, from 1990 to 2010 in Seattle, Washington, USA. We asked the following questions:

1. How were investments in parks related to changes in access to parks?
2. How were investments in parks related to gentrification?
3. How were changes in park access and park investments related to gentrification?

Hypotheses:

1. Park investment is spatially associated with increases in income, home value, and education. If funding for park investment is based on proposals from neighborhoods, those neighborhoods with more highly educated people may be better equipped to submit successful proposals for park improvements. Also, home values may increase because of a perception of improvement in neighborhoods. Therefore, we expect that relatively high investment in parks will be spatially associated with increases in home value, income, and education.

2. Increases in numbers or area of parks leads to increases in park investment. The amenity value of parks depends on their number, area, and the quality of facilities. The amenity value of parks can be increased by increases in park numbers, park area, and investment in park facilities. Investments may be directed at maintaining or renewing existing parks, or improving infrastructure in new parks. As new parks are added to the park system, they attract additional investment. Therefore, we expect that increased investment will occur in locations where park numbers or park area increased over the previous decade.

3. Increased park access and investment in parks is spatially associated with increases in income, home value, and education. Although Seattle has large areas of lakeshore and coast, which provide environmental amenities, parks also are important environmental amenities in Seattle. From 1990 to 2010, census block groups with below-median levels of income and home value had access to significantly less natural passive and multiuse parks, but more recreation parks, compared to census block groups that were above the median. These patterns of association did not change significantly from 1990 to 2010. Therefore, we expect that increased park numbers and park area were spatially associated with increases in income, home value, and education.
2. Study Site

Seattle, Washington, is the largest city in the Pacific Northwest with an area of 217 sq km and a population of 608,255 (US Census, 2010). The racial fabric of the city is mostly Whites (69.5 %), Asians (13.8 %), and Blacks (7.9 %). American Indian and Alaska Native, Native Hawaiian and other Pacific Islanders, and two or more races together make up the remaining 8.8%. In contrast to the state of Washington as a whole, Seattle is highly educated. As of 2010, 57.4 % of the population age 25 and older held a bachelor’s degree or higher, compared to only 31.9% in the state of Washington and 28.8% in the US (United States Census Bureau, 2009-2013). However, less than half of the population of Seattle (46.8%) owns a home, compared to 63.2% in the state of Washington and 64.9% in the US. The proportion of households below the poverty line is 13.6%, which is comparable to the rest of the state of Washington.

The selection of this study site was based on two key factors:

(3) Seattle’s extensive gentrified history should be explored in a spatial context. There is a great deal of media attention surrounding this city and its underlying social processes. Seattle’s Central District transformed from predominately working class African American neighborhoods to mostly White, Asian American, and African American professionals, via gentrification (McGee 2008). More recently, Seattle was featured as being one of the “most gentrified cities in America” (Business Insider.com). In February 2014, The Seattle Times reported that “two masked men blocked a Microsoft employee shuttle on Capitol Hill…condemning the neighborhood’s transformation into an ‘upscale yuppie playground’…[with] skyrocketing rents that are displacing less-affluent, longtime residents” (The Seattle Times 2014).

(4) Seattle’s park system dates back to 1884, and consistent city investment has made it leading park system in the world and an ideal place to explore environmental gentrification. Seattle parks are funded in part from Seattle residents, who have strongly supported park development. In recent years
voters three levies: the Community Center Levy ($36 million, 1999), the Pro Parks Levy ($198 million, 2000), and the Parks and Green Spaces Levy ($145 million, 2008). In addition, the Seattle Department of Parks and Recreation also sought federal, state, and regional funding (Seattle Parks and Recreation, 2014) and has defined a goal of accessibility, to ensure that all residents live within 800m of a park (Harnik 2004).

3. Data sources and Methods

This study descriptive analysis to examine the spatial and temporal patterns of park access and their relationships to socioeconomic variables and trajectories of gentrification. The spatial distribution of park access was described based on changes in numbers, area, and investment in park types within 800m of gentrified, declined, and no change census block groups from 1990 to 2000 and 2000 to 2010.

3.1. Socioeconomic data sources

This study used socioeconomic data for the 1990, 2000, and 2010 US census. The data were acquired from the National Historical Geographic Information System through the Minnesota population center, University of Minnesota.

The geographic unit of analysis for all census related data was the census block group. A block group is a statistical subset of a census tract, and generally contains between 600 and 3,000 people (US Census Bureau 2012). Each block group is uniquely identified allowing it to be represented graphically with a GIS. As of 2010, Seattle had a total of 481 block groups (Figure 1). In 2000 there were 570 census block groups, and in 1990 there were 630. Due to the changing boundaries of census block groups over time, this study aggregated the 1990 and 2000 census block group data to the 2010 census block group area based on an area weighting methodology, which is explained later in this chapter.

Three socioeconomic variables were selected for this study (Table 2). Variables were based on previous research in the quality of life, environmental
justice, environmental gentrification and environmental justice literature (e.g. Jensen 2008, Sieg et al. 2004 and Boone et al. 2009). Median household income and median home value were used to measure the economic status of the population. The percentage of residents 25 and older with bachelor degrees or higher was used as a measure of education (Table 2). In addition, racial groups were considered, including Whites and minorities (Blacks and Asians).

The socioeconomic census data in .csv files and census block groups in shapefile format were downloaded from the National Historical Geographic Information System website. Using ArcGIS10.2.2, the .csv files and shapefiles were imported into the ArcMap data frame. Using the join function, the .csv files and the shapefiles were joined together using their unique identifying object ID number, allowing each census block group to receive its corresponding socioeconomic value.

Table 1. Socioeconomic variables collected by the US Census Bureau (Census Bureau, 1990, 2000, 2010). These variables were used to analyze the process of socioeconomic change from 1990 – 2010.

<table>
<thead>
<tr>
<th>Socioeconomic variables</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race (Whites, Blacks, and Asians)</td>
<td>Percentage of persons belonging to a particular racial group</td>
</tr>
<tr>
<td>Median Income</td>
<td>Median household income in U.S. dollars (with inflation accounted for)</td>
</tr>
<tr>
<td>Median housing value</td>
<td>Median value of owner-occupied housing units in U.S. dollars</td>
</tr>
<tr>
<td>Educational Attainment</td>
<td>Percentage of population age 25+ with high school diploma/ equivalent or bachelor degree or higher as their highest earned degree</td>
</tr>
</tbody>
</table>

3.2. Data on park investment.

This study used the city of Seattle neighborhood matching funds database to assess the amount of park investment within 800m of each census block group from 1990 to 2010. Seattle’s Department of Neighborhoods created the Neighborhood Matching Fund (NMF) program in 1988 to encourage community participation by
providing the financial resources to create small and large projects. Projects can be directed toward building community bonds through educational, cultural, or recreational activities and projects. There are three types of project funds: (1) small parks fund, (2) small and simple projects fund, and (3) large projects fund. Each fund awards community organizations up to $10,000, $25,000 and $100,000, respectively (Seattle Department of Neighborhoods 1995). Although this type of investment is only one of several sources of investment in parks, this dataset was readily available in a useable format for this analysis.

The NMF dataset was obtained from the city of Seattle data portal. The NMF database provides documentation for all awarded neighborhood matching funds from 1989 to present. Information associated with this database include: ID number, Contract number, Program Area (i.e. project fund type), award year, project title, organization name, project description, amount awarded, pledged amount, and the neighborhood being served. The dataset was not available in a form that could be effectively used in GIS or for the purposes of this study. Therefore, the information was processed and filtered to identify which records were associated with park improvements. A Python code was written to sort through the database to find certain park names and projects associated with the study. Once the park name was found, it was written to another excel file. Then using a GIS the new file was joined with the parks shapefiles based on their unique park name. The total amount of the awards was summarized for each park from 1990 to 2000 and 2000 to 2010. To identify which census block groups received funding for parks within 800m, an 800m buffer was placed around each census block group. The park shapefiles were then overlaid on the buffer layer and spatially joined together using a one to many join operation and an intersect match option. The output was a shapefile in which the attributes from one shapefile were joined to the other shapefile based on their spatial relationship. The attribute table and total award money was summarized based on the unique census block group ID to assess the total amount of money that was awarded to parks within 800m of each census block group. After the data was processed and joined with the spatial datasets further analysis could occur.
3.3. Determine changes in park access.

Park access was defined as the number and area of parks within a census block group and within 800 m of the census block group. Changes in park access from 1990 to 2000 and 2000 to 2010 were determined by differencing the fields associated with the number or area of parks within 800m in 2000 from the 1990 field. This was repeated for the 2010 and 2000 fields. Spatial data on changes in park numbers and area for each census block group were obtained from Ch. 2 of this dissertation.

3.4. Identify gentrified census block groups

Gentrification was measured at the census block group level and defined as an increase from below to above-median values for home value, income, and education for periods of 1990 to 2000 and 2000 to 2010. Declining census block groups were defined as census block groups that transitioned from above to below-median in at least two or more categories. Spatial data on gentrified and declining census block groups were obtained from Ch. 3 of this dissertation.

3.5. Define environmental gentrification and how environmental gentrification will be tested.

Environmental gentrification was defined as the spatial association between park investment, increases in park access, and gentrification. GIS layers representing park investment, changes in park access, and gentrification were joined and overlaid. Spatial associations were identified by visual inspection of the resulting maps.

4. Results
4.1. Park investment vs. gentrification.

The number of census block groups which received park investment from 1990 to 2000 was highest for recreation park type and lowest for natural passive park
type (Figure 1a). From 2000 to 2010, the number of census block groups which received park investment was highest for recreation park type and lowest for natural passive park type (Figure 1b). From 1990 to 2000, the average investment for a census block group with parks within 800m was highest for recreation parks, and lowest for natural passive parks (Figure 2a). From 2000 to 2010, average investment for a census block group with parks within 800m was highest for recreation parks, and lowest for natural passive parks (Figure 2b).

From 1990 to 2000, investments in recreation and multiuse parks were made in slightly fewer census block groups that declined compared to those that gentrified or did not change (Figure 1a). From 2000 to 2010, for census block groups that declined and recreation or multiuse parks within 800m fewer investments were made compared to those census block groups that gentrified or did not change. (Figure 1b). From 1990 to 2000, investments in natural passive and multiuse parks averaged only about $30,000 in declining census block groups but were approximately $175,000 in census block groups that gentrified (Figure 2b). From 2000 to 2010, investments in all parks increased for declining census block groups averaging approximately $80,000 for natural passive parks, $180,000 for recreation parks, and $200,000 for multiuse parks. Gentrified census block groups averaged the highest investment values for recreation and natural passive parks but the least in multiuse parks compared to census block groups that did not change or declined (Figure 2b).
Figure 1 Percent of census blocks in this category, in which there was some (nonzero) investment in parks from (a) 1990-2000. and (b) 2000-2010.
Figure 2  Average size of park investment for census block groups which gentrified, did not change, or declined from (a) 1990-2000 and (b) 2000-2010.
4.2. Changes in park access and gentrification.

4.2.1. Changes in park access and gentrification - recreation parks

From 1990 to 2000, census block groups gained up to six recreation parks within 800 m (Figure 3). Most of these increases occurred in central and south Seattle. Census block groups located outside of these areas experienced little to no change in the number of recreation parks within 800m. One gentrified census block group in South Seattle gained four recreation parks within 800m. Census block groups that declined were associated with little to no change in the number of recreation parks within 800m.

From 2000 to 2010, census block groups also gained up to six recreation parks within 800 m. Two distinct hotspots of change in the number of recreation parks are evident. These hotspots are located in North Seattle and at the nexus of four neighborhoods in South Seattle including Downtown, the Industrial District, International District, and North Beacon Hill. Two census block groups in North Seattle gained five recreation parks from 2000 to 2010, and gentrified during the same period. One census block group in the South Seattle hotspot gained three recreation parks within 800m from 2000 to 2010, and also gentrified. Five gentrified census block groups in West and North Seattle gained two recreation parks within 800m. The remaining gentrified census block groups had little to no change in the number of recreation parks within 800m from 2000 to 2010 (Figure 3).
Figure 3 The change in the number of recreation parks within 800m of each census block group compared to gentrified and declined census block groups from 1990 to 2000 and 2000 to 2010.

From 1990 – 2000, most increases in recreation park acreage occurred in four hotspots located in South and North Seattle (Figure 4). The greatest increase in acreage of recreation parks (25 acres per census block group) occurred in South Seattle, in the Central Area and Rainier Valley neighborhoods. In the Downtown area, census block groups gained 20 to 25 acres of recreation park land within 800m. In North Seattle, census block groups in two areas gained 15 to 20 acres of recreation park. However, only one census block group in South Seattle gained more than 25 acres of recreation park from 1990 to 2000 and also gentrified. Another census block group in North Seattle gained 15-20 acres of recreation park and also gentrified. However, other gentrified census block groups had little to no change in recreation
park area. Most census block groups that declined had little to no change in recreation park acreage. However, one census block group in North Seattle gained 15-20 acres of recreation park but declined, and a cluster of census block groups in Downtown Seattle gained 15-20 acres of recreation park from 1990 to 2000, but declined over that period.

From 2000 to 2010, recreation park acreage did not change in most census block groups. A cluster of census block groups just South of Union Lake and another cluster in North Seattle gained 5-10 acres of recreation park within 800m from 2000 to 2010. Most gentrified and declined census block groups had little to no change recreation park acreage from 2000 to 2010 (Figure 4).

Figure 4 The change in the acreage of recreation parks from 1990 – 2000 and 2000 – 2010 in relation to gentrified and declined census block groups.
4.2.2. Changes in park access and gentrification - natural passive parks

From 1990 to 2000 census block groups gained up to four natural passive parks within 800m (Figure 5). Census block groups that gained three or more natural passive parks were mostly associated with declined census block groups or census block groups that did not change with respect to gentrification. Approximately twelve gentrified census block groups gain one or more natural passive parks within 800 m from 1990 to 2000. Most of these gentrified census block groups gained only one additional natural passive park, but one gentrified census block group in the Fremont neighborhood gained two new natural passive parks, and two of the gentrified census block groups gained three natural passive parks within 800 m one (in the Central Area the Queen Anne neighborhood) (Figure 5).

From 2000 to 2010, fewer natural passive parks were added within 800m of most census block groups (Figure 5). Most census block groups did not gain any natural passive parks within 800m. Census block groups that gained two or more parks occurred in North (Northgate and University District), Central District, Rainier Valley and West Seattle. Two census block groups in the Industrial District (adjacent to West Seattle) that gentrified from 2000 -2010 gained three parks in the previous decade (1990 to 2010). In West Seattle, three census block groups that declined from 1990 to 2000 and gained 2 to 3 new parks also gentrified from 2000 to 2010. The same trend is evident in Northeast Seattle, where two census block groups declined from 1990 to 200, but gained two to three new parks, and gentrified from 2000 to 2010 (Figure 5).
Figure 5 The change in number of natural passive parks within 800m of each census block group from 1990 to 2000 and 2000 to 2010, compared with gentrified and declined census block groups during the same time periods.

From 1990 to 2000, the majority of census block groups had little to no change in natural passive park acreage within 800m (Figure 6). Census block groups in West Seattle in the Delridge neighborhood gained 100 to 150 acres of natural passive park land. Gentrified and declined census block groups did not appear to be associated with changes in natural passive park acreage from 1990 to 2000.

From 2000 to 2010, the largest change in area of natural passive parks (354 acres within 800 m) occurred in one census block group in northwest Seattle. Other census block groups in north Seattle gained 100 to 200 acres of natural passive park land within 800m. Most gentrified census block groups had little or no change in
natural passive park area. However, three census block groups in North Seattle, which declined from 1990 to 2000, gained 100 to 150 acres of natural passive park area and gentrified from 2000 to 2010. Declined census block groups appeared to have little to no change in natural passive park area from 2000 to 2010.

Figure 6 The change in the acreage of natural passive parks from 1990 to 2000 and 2000 to 2010 in relation to gentrified and declined census block groups.

4.2.3. Changes in park access and gentrification - multiuse parks

Very few multiuse parks were added within 800m of census block groups from 1990 to 2010 (Figure 7). Three clusters of census block groups located in the Northwest Seattle, Queen Anne, Industrial District, and Beacon Hill neighborhoods
gained at least one multiuse park within 800m. Change in numbers of multiuse parks
did not appear to be related to gentrified census block groups during this time period.

From 2000 to 2010, six clusters of census block groups gained one multiuse park within 800m. The clusters were located in South Seattle (Delridge and Industrial District neighborhoods), Central District, Queen Anne, Magnolia, and three clusters were located in North Seattle. Ten of the 43 census block groups that gentrified from 2000 to 2010 also gained one multiuse park in that period. Four of these were located in the Central Area neighborhood, two in the Queen Anne neighborhood just north of Downtown, one in the Ballard neighborhood, two in the Fremont neighborhood just north of Queen Anne and one in the Northgate neighborhood in North Seattle.

However, approximately 16 census block groups that declined from 2000 to 2010 were also associated with one new multiuse park within 800m during the same time period (Figure 7).
The change in the number of multiuse parks within 800m of each census block group compared to gentrified and declined census block groups.

From 1990 to 2000, although multiuse park acreage did not change within 800 m of most census block groups, a cluster of census block groups in North Seattle gained more than 50 acres of multiuse park area (Figure 8). One census block group adjacent to this area gentrified in the same period. However, multiuse park area did not change within 800 m of the other gentrified and declined census block groups during this period.

From 2000 to 2010, multiuse park acreage also did not change within 800 m of most census block groups. Gentrified and declined census block groups did not appear to be associated with changes in multiuse park acreage (Figure 8).
Figure 8 The change in the acreage of multiuse parks from 1990 – 2000 and 2000 – 2010 in relation to gentrified and declined census block groups.

4.3. Park investment, changes in park access, and gentrification.

4.3.1. Park investment, changes in park access and gentrification - recreation parks

Investments in recreation parks were larger from 2000 to 2010 than from 1990 to 2000 (Figure 1,2, and 9). From 1990 to 2000, census block groups in the Northwest portion of Seattle gained one park within 800m and investment was low. However, from 2000 to 2010, this area became gentrified, and more than $1,000,000 was invested into the recreation parks within 800m of the census block groups (Figure 9). From 1990 to 2000, census block groups in South Seattle gained five or six recreation parks within 800m, and investment in recreation parks was moderate.
($300,000 to $500,000). However, by 2010, this area had slightly higher levels of investment in recreation parks, and one census block group became gentrified. From 2000 to 2010, areas in Northeast and downtown Seattle gained five or six recreation parks within 800m. Park investment in these areas was also high, and several census block groups gentrified in this area over this time period (Figure 9).

Figure 9  Investment in recreation parks compared to the change in number of recreation parks within 800m of each census block group from 1990 to 2000 and 2000 to 2010 in relation to gentrified and declined census block groups.

From 1990 to 2010, park acreage increased in two distinct areas, followed by large investments in recreation parks from 2000 to 2010, which coincided with gentrification in the same census block groups (Figure 10). In Northeast Seattle, census block groups gained 15 to 20 acres of recreation parks within 800m and
$500,000 to $1,000,000 investments in parks from 1990 to 2000. In the subsequent decade, recreation park investments fell to less than $100,000 and most of the area declined from 2000 to 2010. In downtown Seattle, census block groups gained 20 to 25 acres of recreation parks within 800m from 1990 to 2000. In the next decade, recreation park investments in this area exceeded $1,000,000, and the area gentrified. In contrast, census block groups that gentrified in portions of South Seattle and gained more than 25 acres of recreation parks within 800m from 1990 to 2000, declined from 2000 to 2010 but park investment slightly increased (Figure 10).

Figure 10  Investment in recreation parks compared to the change in acreage of recreation parks within 800m of each census block group from 1990 to 2000 and 2000 to 2010 in relation to gentrified and declined census block groups.
4.3.2. Park investment, changes in park access and gentrification - natural passive parks

From 1990 to 2010, the number of natural passive parks increased in three distinct clusters of census block groups, and large park investments and gentrification occurred in the next decade (Figure 11). From 1990 to 2000, in Northwest Seattle, a cluster of census block groups gained two natural passive parks, and less than $10,000 was invested in these parks. However, from 2000 to 2010, investments in the natural passive parks within 800m of these census block groups increased to $500,000 to $1,000,000, and the census block groups gentrified. Similar patterns occurred in the Queen Anne (just west of Lake Union) and West Seattle neighborhoods. Census block groups in these neighborhoods gained four natural passive parks within 800m from 1990 to 2000. Park investment in census block groups in these neighborhoods was moderate ($10,000 to $100,000 per census block group) from 1990 to 2000. In the following decade, investment in natural passive parks in these neighborhoods increased to $500,000 to $1,000,000 per census block group, and some census block groups gentrified (Figure 11).
From 1990 to 2000, each census block group in the Delridge (just east of West Seattle neighborhood) area gained 100 to 150 acres of natural passive parks within 800m (Figure 12). In the following decade, investments in natural passive parks increased to $500,000 and $1,000,000, and census block groups gentrified in this area. In northwest Seattle, large increases in natural passive park area coincided with large investments in these parks and gentrification from 2000 to 2010 (Figure 12).
Figure 12  Investment in natural passive parks compared to the change in acreage of natural passive parks within 800m of each census block group from 1990 to 2000 and 2000 to 2010 in relation to gentrified and declined census block groups.

4.3.3. Park investment, changes in park access and gentrification - multiuse parks

Overall park investment was not obviously associated with changes in the number of multiuse natural parks (Figure 13). Most investment in multiuse parks occurred in census block groups located along the Puget Sound and Lake Washington and in North Seattle (Figure 13). From 1990 to 2000, the highest investment in multiuse parks ($500,000 to $1,000,000 per census block group) occurred in South Seattle, but this area did not gentrify in the following decade; in fact, census block groups declined. However, in other parts of Seattle, census block groups that declined had small investments (up to $100,000 per census block group) and little to
no change in the number of multiuse parks from 1990 to 2000. Gentrified census block groups had a wide range of investment in multiuse parks from 1990 to 2000. One gentrified census block group in the lower Central District had between $500,000 and $1,000,000 in multiuse park investment within 800m. The following decade this census block group declined but park investment increased to more than $1,000,000 (Figure 13).

From 2000 to 2010, investment in multiuse parks exceeded $1,000,000 in six census block groups, which were all located in South Seattle. The smallest investments for multiuse parks within 800m of census block groups appear to be dispersed uniformly across North and West Seattle. Gentrified census block groups appeared to be associated with all levels of park investment. Gentrified census block groups that had high levels of multiuse park investment were found in Central District, Queen Anne¹, Magnolia², and Ballard³.
Figure 13 shows the multiuse park investment compared to the change in number of multiuse parks within 800m of each census block group from 1990 to 2000 and 2000 to 2010 in relation to gentrified and declined census block groups.

In most cases, increases in multiuse park acreage were not associated with large investments (Figure 14). However, in some cases, census block groups gentrified and also had high levels of park investment within 800m. The Northeast corner of Seattle gained the largest amount of multiuse park acreage from 1990 to 2000 (81 acres), and one census block group adjacent to this area gentrified. From 2000 to 2010, four census block groups in the Magnolia neighborhood gained 10 to 30 acres of multiuse park area, and this coincided with park investments of $500,000 to $1,000,000. One of these census block groups gentrified during this time period. Some census block groups along Lake Washington in South Seattle had little to no
change in multiuse park acreage but received more than $1,000,000 in investments in multiuse parks.

Figure 14  Investment in multiuse natural parks compared to the change in acreage of multiuse natural parks within 800m of each census block group from 1990 to 2000 and 2000 to 2010 in relation to gentrified and declined census block groups.

5. Discussion

Gentrification, measured as an increase from below to above-median levels of home value, income, and education, was expected to be associated with increases in park numbers and park area in the same time period. However, the results were not consistent with this expectation: only two census block groups with very large changes in the acreage of recreation parks from 1990 to 2000 and natural passive...
parks from 2000 to 2010 also gentrified in the same period. I found that numbers and acreage of parks do not predict gentrification, but the addition of information on park investment reveals strong lagged relationships. In census block groups where numbers and areas of parks increased, followed by high investments in parks, led to gentrification. In the Downtown and South Lake Union neighborhoods, acreage of recreation parks increased from 1990 to 2000, moderate ($300,000 to $500,000) to high ($500,000 to $1,000,000) park investments occurred from 2000 to 2010, and these areas gentrified.

Traditional trajectories of gentrification suggest that growth in professional and business services coupled with high technology jobs would lead to gentrification in Seattle (Morrill 2008). However, the trends found in this study are indicative of processes that are far more complex than the traditional notions of gentrification as merely changes in socioeconomic status. The results suggest that changes in access to, and investment in, differing park types (particularly natural passive and recreation parks) may play a significant role in explaining social, economic, cultural, and in some cases, racial changes to census block groups in Seattle, Washington.

The environmental gentrification literature is traditionally associated with environmental hazard cleanup sites that relate to the increased attraction of the area and ultimately lead to gentrification (Banzhaf and McCormick 2007, Eckerd 2011). The processes described in this study fit the definition of environmental gentrification because improvements in the landscape (i.e., increased numbers and area) appeared to catalyze the process of gentrification in the following decade and led to the displacement of vulnerable populations. Abel et al (2015) argued that gentrification accompanied and at times preceded environmental improvements in Seattle. However, this study assessed environmental gentrification in terms of park access and investment, and provides new evidence that spatial patterns of gentrification can be attributed to changes in the numbers, areas, and investment in parks in Seattle.

This study examined the relationships of changes in three different types of parks to trajectories of gentrification. Some research has suggested that the causes of gentrification are well understood. However, this study shows that gentrification is
far too complex to attribute to simple factors, and that the causes of gentrification are multifaceted, dynamic, and spatially variable. Although environmental gentrification is occurring in Seattle at the census block group level, the patterns and processes differ among neighborhoods. Changes in certain types of parks may be more related to gentrification than others. High levels of park investment at the neighborhood level also appear to be a strong predictor of gentrification. High-income, relatively more educated community groups may be more organized and more successful in competing for funding for parks.

These findings also suggest that moderate investment in parks may not necessarily lead to gentrification. This is a strategy called, "just green enough." The "just green enough" strategy is based on the idea that communities can enhance their parks by small improvements, without spurring the process of gentrification (Curran and Hamilton 2012). If communities restrict park improvement projects to moderate levels and ensure that they are designed by and for the community, park investment may avoid gentrification.

6. Conclusion

Gentrification is a multifaceted, dynamic and spatially variable process. Research on the causes of gentrification is transcending early theories of cultural and economic changes to examine the role of environmental improvements. Increases in park access, when combined with high levels of investment in parks, appeared to explain spatial patterns of environmental gentrification in Seattle. The process of environmental gentrification also seems to be sensitive to changes in different park types. These findings contribute to the environmental justice because they reveal persistent inequities in the distribution of environmental goods in Seattle. More research is needed to explore relationships of park access and investment and their relationship to gentrification and environmental justice in Seattle.
7. Literature Cited


**Chapter 5 - Conclusion**

In this study I examined the relationships among different factors including wealth (household income and home value) and education, race, perceptions of gentrification park access and investment in parks. In short I sought out to understand how these factors were related to the spatial patterns of gentrification environmental justice and concepts of land use planning.

Revisiting the Society and Land Use conceptual model adapted from Platt, will help to define the gains made by this research and understand where this research needs to go in the future.

![Figure 1. The modified Society and Land use model (adapted from Platt, 2004).](image-url)
In Chapter 2 I examined the relationships among park access and development of new parks by type, wealth, education, and racial patterns, in order to understand how park system evolution is related to environmental justice. I found that park access differed among socio-economic groups, and by park type. Significantly greater proportions of minorities were found in census block groups with below–median levels of education, income, and home value, which were related to significantly larger numbers and more areas of recreation parks. I also found that park development had the effect of maintaining differences in park access based on socio-economic variables. The modified Society and Land Use model shows how the socio-economic variables feed into the legal realm and inform the resource management and the type of parks that are developed and where. Over time Seattle has seen a large increase in the number and size of parks largely due Seattle voters positively expressing the need for park space through the approval of bonds and levies. However, this study found disparities in park access by park type and socio-economic group. Understanding the historic development context of the Seattle park system is an important factor that deserves more attention in the future. It invokes the question: Is there a systemic approach that reinforces an uneven distribution of park access? This portion of the research could be enhanced by interviewing key park managers on the role that park planning has taken over the years and whether or not it has targeted certain neighborhoods for development of particular park types. It is important for community planners to recognize that there may be disparities in access to parks based on park type.

In chapter 3 I examined gentrification over two decades, using quantitative analysis of census data on education, home value, income, and race, as well as qualitative analysis of media content. This chapter focuses on the characteristics and trends of the economic and social data vector of the Society and Land use Model (Figure 1). It not only characterizes the economic and social data vector but breaks it down to reveal its own dynamic process. I found gentrification to be a dynamic and variable process that exists on a continuum rather than being a binary process. I identified three trajectories of gentrification. Gentrification was defined as change from below to above the median value for education, income, and home value in a
census block group over the period 1990 to 2000 or 2000 to 2010. Census block groups showing this trend were signified as Gentrification A. Nine percent of census block groups met the definition of gentrification in each of the two decades. Some of the gentrified census block groups were also accompanied by large declines in proportions of African Americans in the population. However, gentrification in terms of education, income, and home value also occurred in areas that did not have large proportions of minorities. The interaction of wealth and education as it related to racial change and gentrification was another trajectory identified as Gentrification B. The last factor added was media perceptions of gentrification. We found that perceptions of gentrification were reported in places that met the definition of gentrification, but also in areas experiencing changes in minorities, but which did not yet meet the definition of change in terms of education, home value, and income. This interaction was identified as Gentrification C. I also found that Census block groups gentrified in a clustered manner and Census block groups that gentrified from 2000 to 2010, tended to be in close proximity to other Census block groups that gentrified in the previous decade from 1990 to 2000. This trend suggests that gentrification may have a contagion effect.

Studying trajectories of gentrification in this manner adds to the dialogue of change especially concerning how people perceive the change in their neighborhood even when gentrification may not be detected. Further research on this dynamic process presents a unique opportunity for community leaders and planners to identify whether or not perceptions of gentrification are actually precursors to it being detected in census data and other quantitative methods. In practice this is an opportunity for communities to combat or brace themselves for impact. It may serve as a window for local government to reinforce or target social programs and initiatives to certain areas. Community leaders may use this as means of foreseeing and sideling the typical pitfalls that other gentrified communities have struggled with. For example, the content analysis in this research identified that gentrification stifled the community bonds and sense of togetherness. Therefore, community initiatives may focus on strengthening the community so that it reinforces or reestablishes its identity, allowing newcomers including businesses and other
gentrifiers to not change but enhance the already vibrant nature of the community. Other initiatives may target long standing residents, both home owners and renters. Local housing authority can work to ensure that affordable housing is maintained as developers move into the communities. Gentrification is a multifaceted yet slow process. The slow nature of gentrification can be a beneficial feature of the process or act as a buffer to help individuals and the community at large to prepare for the changes that may occur.

The research conducted in Chapter 3 was limited in two areas: (1) the time frame being too short and (2) the content analysis focusing on the negative perceptions of gentrification. As previously mentioned gentrification is a slow process a two decade time frame is just a small window or snap shot in time which makes it difficult to effectively draw conclusions and analyze trends. Future research should provide a more robust timeline in order to gain a fuller picture of the evolution that the city of Seattle has taken. Secondly, the approach to conduct the media content analysis was limited due its keywords. The keywords used rendered an overwhelming response of negative perceptions of gentrification. Gentrification for many has been seen as a negative process due to its ability to displace low income and minority persons. However, not everyone is of the same mindset and to some gentrification is seen as a process that brings vitality back to their neighborhood and is gladly welcomed. This research did not find particularly find perceptions of gentrification even in areas where gentrification is a known process to be occurring. This may have occurred because the community is not reporting about gentrification or because the search terms, as mentioned were limited due to their negative connotation. Further research should broaden search terms to include positive terms of gentrification. Another means of creating a more robust research agenda of perceptions is to conduct interviews within and surround the gentrified Census block groups. Interviews at all levels of the community would be beneficial for the research including; local business owners, renters, home owners, community leaders and activists, as well as corporate business owners, and city officials communities.
Chapter 4 refocuses its attention on the interrelationships of the modified Society and land use model. Spatial patterns of park access were compared to the process of gentrification. Spatial data on community-initiated investment in parks were also compared to spatial patterns of change in park access and socio-economic characteristics. Using the Society and Land Use model I explore the interactions between the physical realm and changes in counts or area of park types, the economic and social data vector as it relates to trajectories of gentrification that feeds into the legal realm as it relates to the private sector with community directed investment which informs the resource management vector to implement investment decisions on the land use system and different park types being established in certain areas (Figure 1). This study had surprising results in that, numbers and acreage of parks did not predict gentrification. However, the research did reveal strong lagged relationship with the addition of park investment information. I found that gentrification was associated with locations where the number and acreage of recreation and natural passive parks increased from 1990 to 2000, and where high levels of park investment were present. More research is needed to explore the causation of gentrification and environmental gentrification. This research suggests that changes in access to and investment in, differing park types (particularly natural passive and recreation parks) may play a significant role in explaining social, economic, cultural, and in some cases, racial changes to census block groups in Seattle. In the event that the Seattle’s parks are significantly contributing to the processes of gentrification it is important for community leaders to take action. The research was limited by the park investment information used as it only pertained to community directed investment in parks from one source of funding (the Department of Neighborhoods Matching fund). Two steps should be taken in the future to create a more robust account of park investments: (1) inclusion of all park investment including but not limited to – park maintenance, nonmonetary investment (via volunteer clean up groups), and private action groups, (2) analyzing a complete dataset of accepted and rejected grant applications. This research deserves more attention regarding all park investment to parks which includes both public funding as well as privatized investment. Including all park investment may render more robust results about where money is being
invested and whether or not it is related to changes to economic and social characteristics of neighborhoods. Moreover, analysis of privatized investment in parks may speak to the social and cultural capital and organization that communities may have over others. Secondly, analyzing a more complete database of public grants/investment using both accepted and rejected grant applications would be useful to identify if there was a disproportionate number of applications rejected in disparate neighborhoods compared to applications being rejected in other neighborhoods (e.g. Wolch et al. 2005). An analysis such as this one may reveal an institutionalized systemic process of oppression that should be addressed in order ensure that equity is being met for all communities.

This last chapter also creates an opportunity for further discussion and research on managing park development/improvement decisions about park location, access and investment to satisfy equity without promoting gentrification. As discussed in Chapter 4, there is a call by Curran (2012) for communities to focus on being “just green enough.” Environmental gentrification like traditional gentrification can have the effect of displacing its residents and changing the social, cultural, and economic dynamics of neighborhoods. Other research has shown that when communities take on projects that are too large of a scale and do not consider the immediate needs of the residents it can balloon and ultimately attract more attention than it originally desired and the effect is displacement (Curran 2012). The study presented on Seattle park investment as it relates to gentrification is the tip of the iceberg and requires a great deal of research to thoroughly determine the effects of community initiated investments in park development and improvement. However, community leaders should consider implementing appropriately scaled projects that are created by and for the residents of the community (Curran 2012). To enhance future research on this topic, I suggest that an in depth case study be conducted on various neighborhoods that completed community projects of different sizes and assess whether or not it played a role in the area experiencing gentrification or not.

Overall, this research is lends itself to furthering the environmental justice literature by reinforcing the importance of equitable distribution of environmental goods. It also suggests that it may be important to distinguish between differing types
of parks to ensure that all community types have access. My research also informs the gentrification literature by introducing a simplistic methodology for practitioners to carry out in their respective cities. Further research and development activities should be done to create a web application tool that can be used to quickly identify whether or not a city or community is gentrifying or has gentrified or experiencing perceptions of gentrification. Creating access to this type of information may help individuals effectively plan and brace for impact within their community.