Evaluation of Livability in Northwest Portland

Noise and Other Nuisances in a High-Density, Mixed-Use Neighborhood

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The Center for Urban Studies

Portland State University

Final Report
September 5, 2000

For the City of Portland
Bureau of Environmental Services

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Abstract

The purpose of this study is to assess the effect of an experimental program to restrict the timing of garbage and recycling collection in a high-density, mixed-use Northwest neighborhood of Portland, Oregon, with an emphasis on how the experimental restrictions affected the perception of noise by neighborhood residents and businesses. **In general, our research found mild to moderate decreases in noise annoyance related to garbage-collection activities during the experimental period**.

The sounds generated by garbage and recycling collection in mixed-use areas like Northwest Portland present a particular problem, because they tend to exceed 75 decibels, well beyond the decibel level that will awaken most people, and because they are generated by a combination of residential and commercial haulers, the latter not being regulated by the City of Portland.

In response to Northwest residents' concerns with bothersome noise, the City's Bureau of Environmental Services implemented an experimental program to restrict commercial garbage- and recycling-collection times in an approximately one-square-mile section of Northwest Portland, where mixed land uses and densities are highest (the "experimental area"). The City prohibited garbage and recycling collection between the hours of 10 p.m. and 6 a.m., seven days a week, during the period from September 6, 1999, to October 31, 1999. The City contracted with Portland State University to evaluate the effects of this program. We administered a pre- and posttest survey to assess changes in perceptions of noise and other livability factors. We randomly selected 650 residents and 150 businesses and administered the surveys by mail, followed up with reminder postcards and surveys. Our resident response rate was 27 percent for the pretest and 19 percent for the posttest. Business rates were slightly lower—19 percent for the pretest and 15 percent for the posttest. We classified survey responses according to three geographic zones: a Commercial Zone; a Spillover Zone, outside of the experimental area (including the Pearl District); and the In-Between Zone, the area immediately surrounding the Commercial Core.

To gain a sense of Northwest residents' general feelings toward their neighborhood, the survey asked respondents to compare Northwest Portland with other Portland neighborhoods as a place to live, on a scale ranging from "much better" to "much worse." Over 85 percent of the residents in each phase of the study responded that Northwest Portland is a better place to live than other Portland neighborhoods. Respondents placed the greatest value on proximity to activities. In terms of negative attributes, parking, traffic, and property crime are top-ranking concerns of Northwest Portland residents, followed by the presence of homeless people, pedestrian-auto conflicts, and street drinking. Noise related to garbage collection ranked seventh or below, after these top-ranking problems.

With respect to the issue of noise, 84 percent of the respondents said they had been bothered by noise outside their home in the two weeks before the experimental program began, while only 75 percent said they had been bothered during the experimental period. **During the experimental period, the perception of garbage-related noise as a problem dropped by a greater percentage (17 percent), on average, than did the perception of the other sources of noise (an average drop of only 10 percent).** About 40 percent of the respondents indicated that their sleep had been disturbed by outside noise two to three times over the past two weeks. **Noise from garbage collection and dumping and from recycling collection—two of the top three sources of sleep-disturbing noise identified before the experimental program—both became less important sources of sleep-disturbing noise during the experimental program.**

This study also looked at unintended negative consequences ("spillover effects") and found that **increased perceptions of garbage-related noise did not occur in the Spillover Zone**, except with respect to garbage trucks driving on the street. There was **no difference in perceptions of traffic congestion** among residents surveyed before and during the experimental program. **Among business owners, noise in general is not a high-priority concern**. During the experimental program, there was an increase in concern about garbage collection noise from businesses outside of the Commercial Core, but the increase was very small. Finally, although a permanent time restriction on commercial garbage collection might have an effect on both residential and commercial collection costs and, hence, increased prices for the consumer, we did not assess this, though it remains an important policy consideration.

Sociodemographically, this research suggest that **there is a relationship between density and noise annoyance**, with residents who live in denser areas being more likely to report noise as a problem. Our results also suggest that **those who rate their neighborhood worse than other neighborhoods are far more likely to consider noise a problem** than those who rate their neighborhood as better than or the same as other neighborhoods. Finally**, younger adults are more likely to report being bothered by noise than are older adults**, the majority of whom indicated it was either not a problem or, at worst, an inconvenience.

In conclusion, the findings of this research suggest that prohibiting garbage collection in Northwest Portland between at least 10 p.m. and 6 a.m., if not 7 or 8 a.m., is very likely to improve the quality of life associated with garbage-related noise. We know that garbage-collection noise is annoying—profoundly so—for some residents in Northwest Portland. We also know that urban noise pollution, from a variety of sources, is likely only to worsen as densities and mixing of land uses increase. **It is important to remember, though, that other problems associated with dense urban living are even more bothersome** and equally likely to worsen. It is for the public and policy-makers to prioritize the targets of problem solving and to work together toward a cooperative, consensus-based framework for addressing not only current problems associated with urban living, but those that are bound to intensify in the future as the city and the region grow.

Introduction

Noise in a close urban setting emanates from many sources, most of which are unavoidable features of the city: emergency vehicle sirens; automobile alarms; traffic, including large vehicles such as delivery trucks and buses; music and conversation associated with entertainment venues; the activities and conversation of neighbors, visitors, and businesses; police, tourist, and news helicopters; and garbage and recycling activities such as banging of refuse containers, compacting, breaking recyclable glass, and trucks beeping when backing up or reverberating as they make their way through city streets.

The purpose of this study is to assess the effect of an experimental program to restrict the timing of garbage and recycling collection in the high-density, mixed-use district of Northwest Portland, with an emphasis on how the experimental restrictions affected the perception of noise by neighborhood residents and businesses.

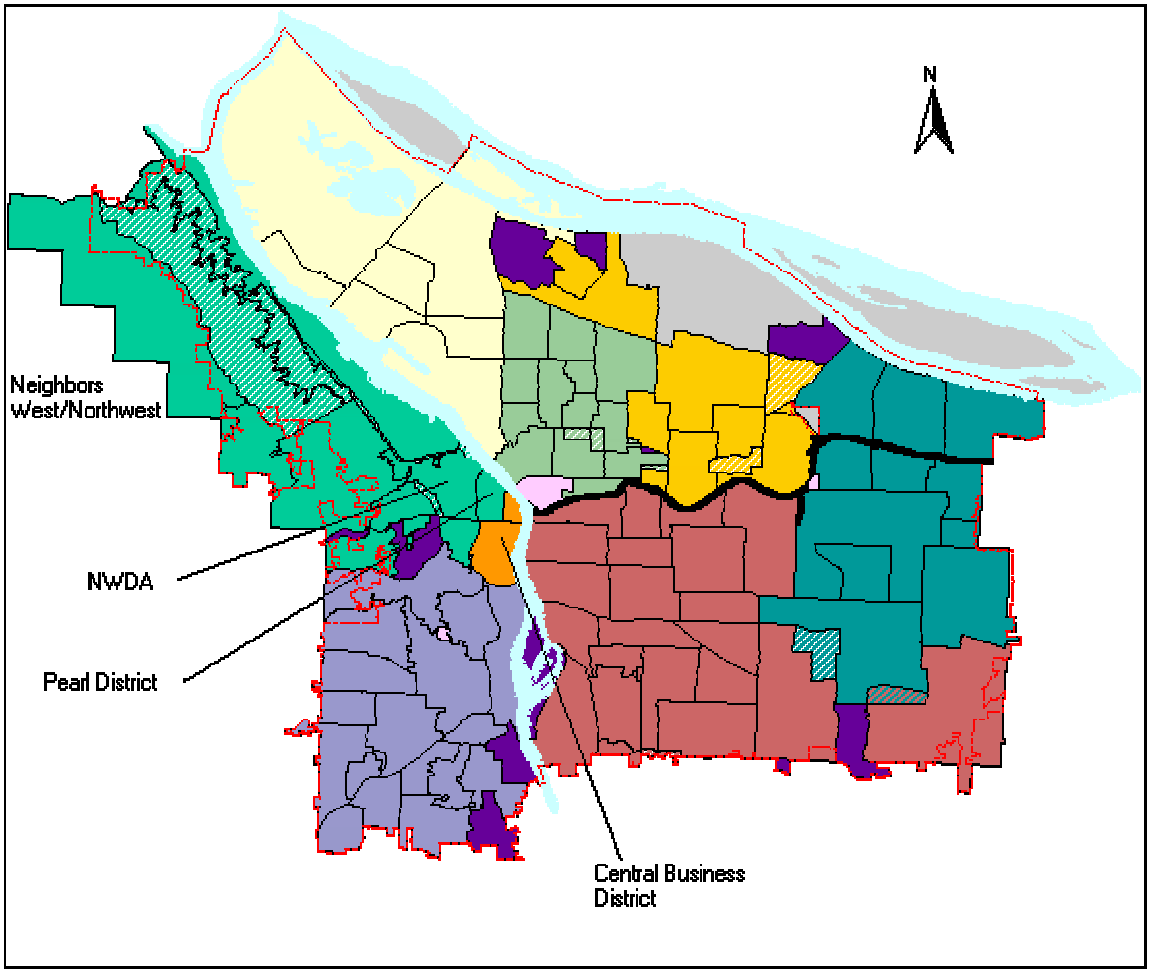
One common definition of noise is "unwanted sound." Important characteristics of sound include its level (measured in decibels–dB), averages of its energy over time, duration, and frequency. The Environmental Protection Agency (EPA) has determined that a safe day-night average sound level is 55 dB. This is about the equivalent of normal, quiet conversation. The loudest natural sound on earth – thunderclap – registers 120 dB. Most sounds associated with garbage and recycling collection are 75 or 80 dB at minimum. In addition, many of these sounds are "impulsive" and "intermittent," which makes them more annoying because of their unpredictability.

In the 1970s, the EPA became concerned with urban noise, and state and local governments received funding for noise abatement. Such programs were eliminated in 1981. At present, Portland's City Code prohibits nighttime noise ranging from 50 dB in residential areas to 65 dB in commercial areas. Impulse sounds are limited to 80 dB at their peak during the night. Portland's Noise Control Office is staffed by one person, who investigates noise complaints. Police officers also field noise complaints, as does the Bureau of Environmental Services (BES), which regulates the city's garbage and recycling collection.

Through administrative rules, BES prohibits residential garbage and recycling collection between 10 p.m. and 6 a.m. Commercial garbage and recycling collection is not regulated, except in the core of downtown, where it must occur during the nighttime hours. Garbage and recycling collection in mixed-use areas like Northwest Portland presents a particular problem. These areas may contain both commercial and residential buildings in close proximity to one another. Because there is no restriction on the timing of commercial collection, much of it does in fact tend to occur in the nighttime hours. Residents of mixed-use areas may be disturbed by commercial nighttime collection occurring one building or one block down the street. In Portland, this noise may occur at any time of the night, including the early-morning hours of 2 a.m. to 6 a.m. Sleep disruption during this time period may be particularly deleterious, because this is when the lightest sleep phase occurs. Rapid eye movement, body movements, cardiovascular responses, and next-day performance quality and mood may all be adversely affected. Effects are more severe in the elderly.

Northwest Portland has an active neighborhood association, the Northwest District Association (NWDA), which has been increasingly concerned with urban noise as the neighborhood develops rapidly into a mixed-use activity center, tourist destination, home to many multi- and single-family

residents, and one of the densest areas in the entire state. The effect of urban noise on the quality of life in Northwest Portland is the focus of this report.



Map E.1. Portland central city with its seven neighborhood coalitions, including the Neighbors West/Northwest Coalition, consisting of ten neighborhoods, in the northwest quadrant. The study areas of the Northwest District Association (NWDA) and the Pearl District are indicated. (Source: City of Portland Planning Bureau, Metro RLIS[1]).

Study Methodology

In the fall of 1999, the City of Portland's Bureau of Environmental Studies (BES) implemented an experimental program to restrict commercial garbage- and recycling-collection times in an approximately one-square-mile section of Northwest Portland, where mixed land uses and densities are highest (the "experimental area"). The City prohibited garbage and recycling

[1] From Portland Neighborhood Coalitions web page, accessed on 26 August 2000, at <http://duck.co.multnomah.or.us/pmpb/toppage.cfm>.

collection between the hours of 10 p.m. and 6 a.m., seven days a week, during the period from early September 1999 to the end of October 1999. The City contracted with Portland State University to evaluate the implications of this program. We administered a survey in two phases—one before (the "pretest") and one during the experimental program (the "posttest")—to evaluate the effects of the experimental program on perceptions of noise and other livability factors.

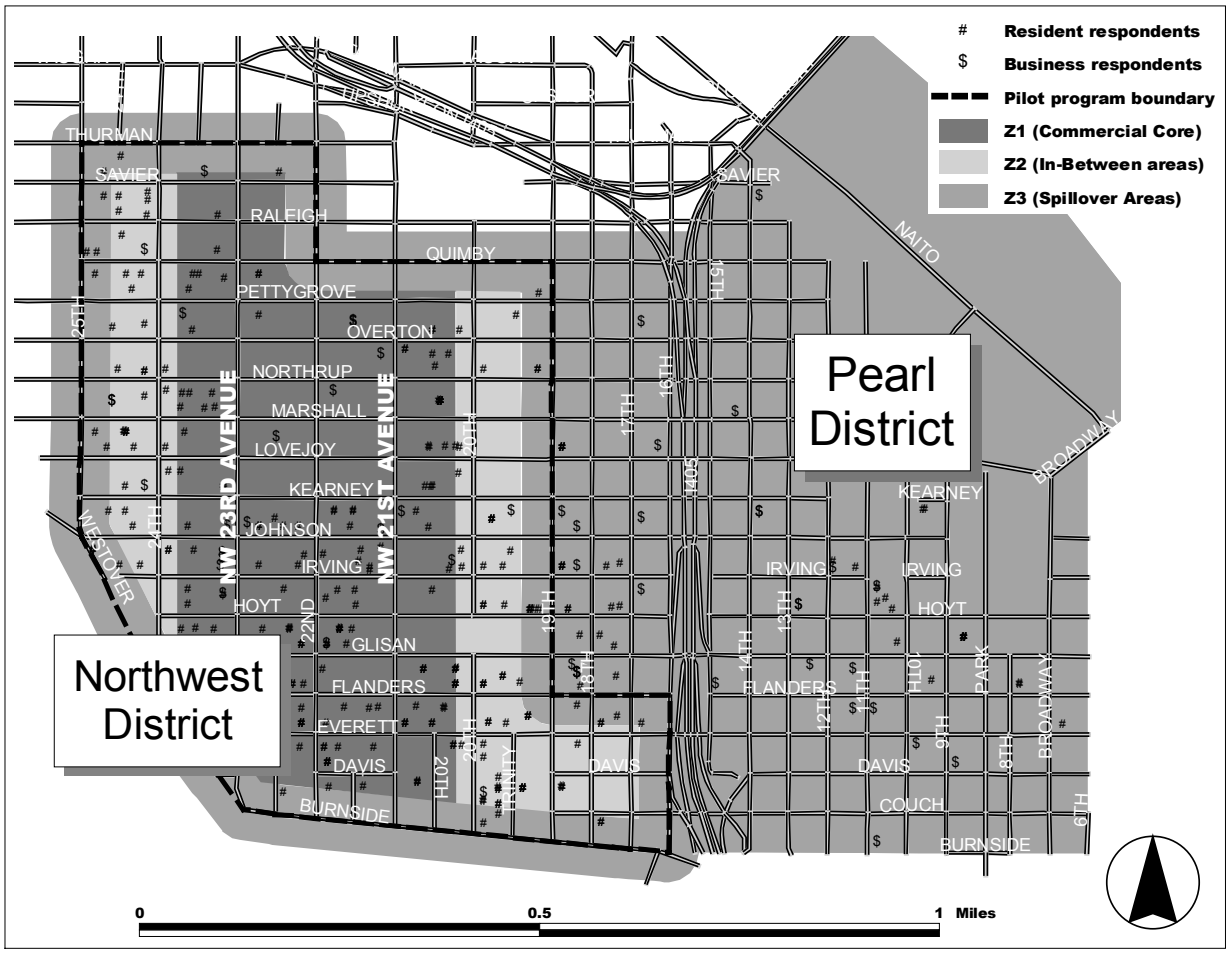
We based the 1999 survey on a previous survey we had administered in 1994. That survey included questions about livability that had been identified by focus group interviews we had conducted. We modified the 1999 survey to reflect the present emphasis on garbage-collection noise. As in the 1994 study, residents and business owners received similarly designed surveys. The surveys address five broad categories: general livability, noise, traffic, parking, and sociodemographic characteristics of the respondents.

After pilot testing the new survey, we randomly selected 650 residents and 150 businesses from a sampling frame of approximately 2630 residents and 1220 businesses provided by a commercial database supplier. We administered the pretest surveys by mail, approximately three weeks before the experimental program began, sending 600 of the residential surveys to the experimental area in Northwest Portland and 50 to the Pearl District, adjacent to Northwest, but outside the boundaries of the experimental program. We sent follow-up surveys to nonrespondents approximately two weeks after the initial mailing.

The experimental program began on September 6, 1999. To ensure that our pretest surveys captured only baseline conditions, we accepted no surveys postmarked after September 8. So that our posttest surveys would capture conditions present *during* the experimental program, we sent the posttest surveys out to another random sample of 650 residents and 50 businesses six weeks into the experimental program. We sent out reminder postcards to nonrespondents about ten days after the initial posttest mailing. The experimental program ended on October 31, 1999. We accepted no posttest surveys postmarked later than November 5.

Budget constraints, vacation season, and the fact that Northwest is a frequently studied area all account in part for the small resident response rate of 27 percent for the pretest and 19 percent for the posttest. Business rates were slightly lower: 19 percent for the pretest and 15 percent for the posttest.

We classified survey responses according to three geographic zones, which serve as the basis for our analysis of the data (see Map E.2). Zone 1 is the Commercial Core, the area within 200 feet of the commercial corridors of Northwest 21st and 23rd avenues. We expected this zone to experience the most dramatic impacts of the experiment. Zone 2 is the In-Between Zone, the area immediately surrounding the Commercial Core. We expected less dramatic results here. Zone 3, the Spillover Zone, is the area outside of the Commercial Core and the In-Between Zone, extending 200 feet beyond the experimental area boundaries. We anticipated that these areas would experience some spillover impacts from the experimental program. This zone included the Pearl District.



Map E.2. The Northwest Neighborhood, by analysis zones. (Source: Portland State University).

Findings with Respect to Livability

To gain a sense of Northwest residents' general feelings toward their neighborhood, the survey asked respondents to compare Northwest Portland with other Portland neighborhoods as a place to live, on a scale ranging from "much better" to "much worse." Over 85 percent of the residents in each phase of the study responded that Northwest Portland is a better place to live than other Portland neighborhoods (see Figure E-1).

What is it about Northwest that residents value? Respondents placed the greatest value on proximity to activities: the ability to walk to activities and the close proximity to downtown rank as the neighborhood's top two quality-of-life features, both before and during the experimental program. These two aspects of Northwest Portland also ranked most and second-most important in the 1994 study. Responses regarding what makes Northwest Portland a good place to be were fairly consistent across the Commercial Core, In-Between, and Spillover zones.

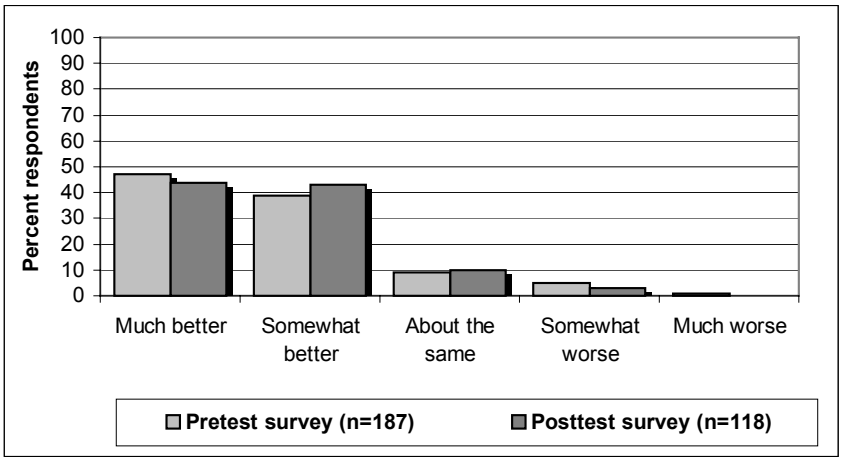


Figure E.1. Resident responses to how NW Portland compares with other neighborhoods as a place to live. (Source: Northwest Livability Study, PSU 1999.)

In terms of negative attributes, parking, traffic, and property crime continue to be top-ranking concerns of Northwest Portland residents, followed by the presence of homeless people, pedestrian-auto conflicts, and street drinking. Noise related to garbage collection ranked seventh or below, after these top-ranking problems (see Table E.1).

Table E.1. Percentage of resident respondents agreeing that factor is a neighborhood problem. *Factors that fell in rank* o *are indicated in bold italics.* (Source: Northwest Livability Survey, PSU 1999.)

Are these problems in Northwest Portland?	"Agree" responses *before* experiment[a]		"Agree" responses *during* experiment[b]	
	Percentage	Ranking[c]	Percentage	Ranking
Too little parking	***78***	***1***	***74***	***2 o***
Auto theft and break-ins	76	2	77	1 ρ
Vandalism	66	3	65	3
Too much traffic	61	4	59	4
Presence of homeless people	***51***	***5***	***41***	***8 o***
Pedestrian/auto conflicts	50	6	56	5 ρ
Street drinking	47	7	46	6 ρ
Traffic noise	**43**	**8**	**44**	**7 ρ**
Garbage collection noise	43	9	40	9
Too many outsiders using area	***30***	***10***	***21***	***13 o***
Night life noise	***27***	***11***	***22***	***12 o***
Recycling collection (glass, etc.)	***23***	***12***	***23***	***10 o***
Hard to find basic goods	***17***	***13***	***23***	***11 o***
Too many bars	15	14	15	14

[a] n = 192 [b] n = 123 [c] Ranking reflects percentage before rounding

Findings with Respect to Noise

Noise as an overall problem

Figure E.2 shows that, when asked about "noise overall," about 40 percent of the respondents indicated that noise was a problem before the experiment; during the experiment, this dropped to about 34 percent. Figure E.3 shows that 84 percent of the respondents said they had been bothered by noise outside their home in the two weeks before the experimental program began, while only 75 percent said they had been bothered during the experimental period.

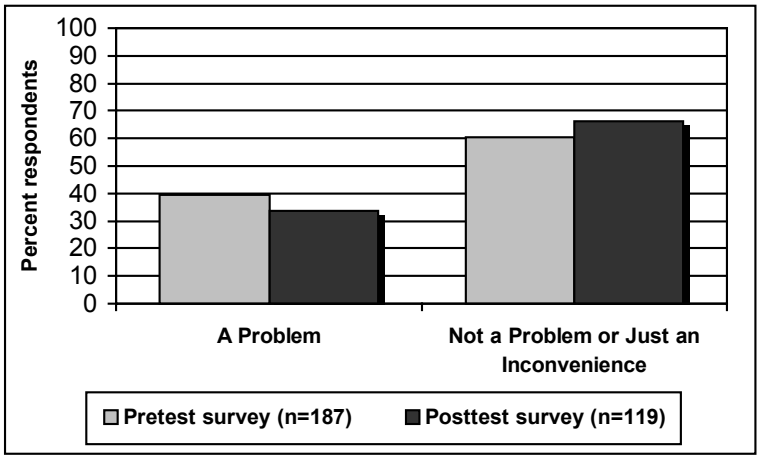


Figure E.2. Distribution of residents believing that overall noise is not a problem or just an inconvenience versus those who feel that overall it is a problem. (Source: Northwest Livability Survey, PSU 1999).

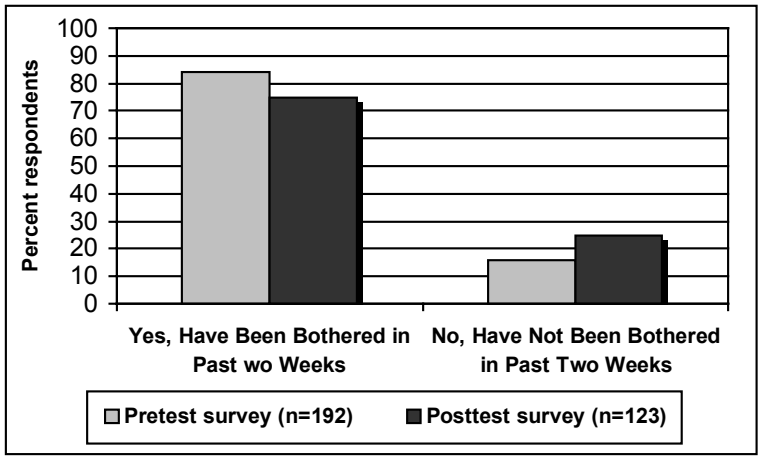


Figure E.3. Distribution of residents indicating whether they have been *bothered by noise outside their home* in the past two weeks. (Source: Northwest Livability Survey, PSU 1999).

Sources of bothersome noise

As for different sources of bothersome noise, Figure E.4 illustrates that the largest percentage of people identified anti-theft alarms on cars or buildings as a problem. This is followed by "people outside talking loudly or shouting" and "garbage collection and dumping." In the pretest period, 48 percent of the respondents rated both of these sources as problematic. In both cases, the percentage fell in the posttest period—to 42 percent rating people talking loudly and 43 percent rating garbage collection as problematic noise sources.

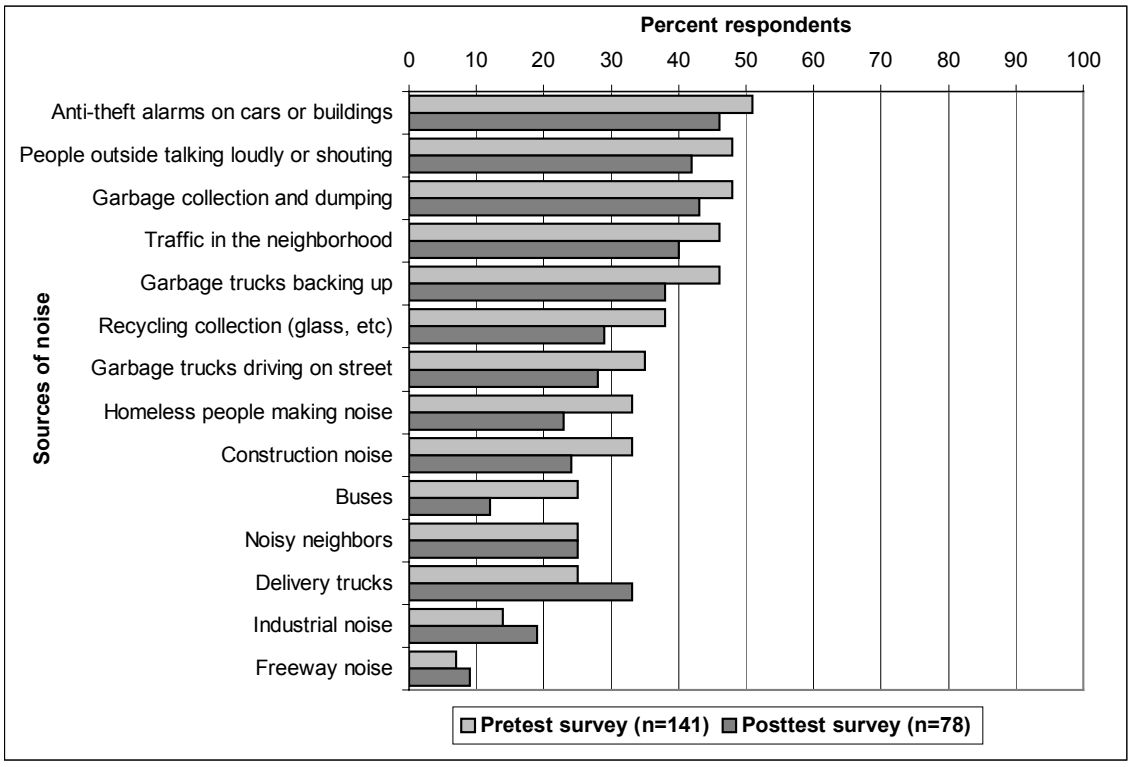


Figure E.4. Percentage of residents who responded that noise source was a problem for them in the past two weeks. (Source: Northwest Livability Survey, PSU 1999).

Garbage-related noise

During the experimental period, the perception of garbage-related noise as a problem dropped by a greater percentage, on average, than did the perception of the other sources of noise. As Figure E.5 indicates, an average of 41 percent of the respondents indicated that garbage-related noise sources were a problem before the experiment. This dropped by over 17 percent to only 34 percent of the respondents in the posttest period. By contrast, an average of about 31 percent of the respondents rated all other sources of noise as a problem before the experimental program. This dropped by only 10 percent during the experimental period.

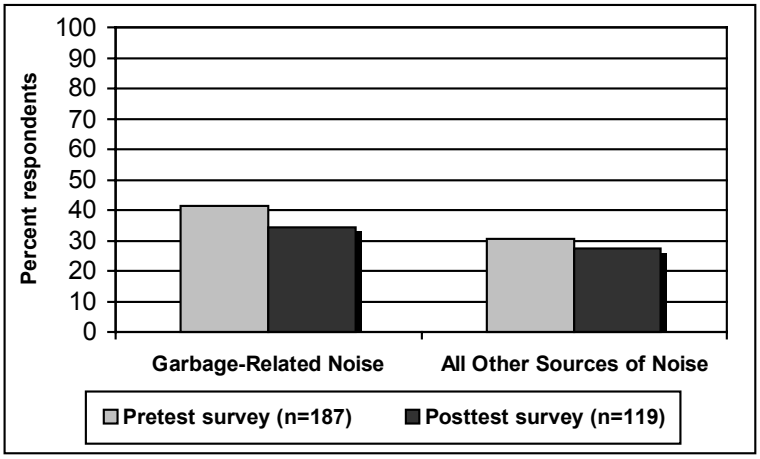


Figure E.5. Average percentage of respondents indicating that all garbage-related noise sources were a problem compared with the average number indicating that all other sources of noise were a problem. (Source: Northwest Livability Study, PSU 1999).

Garbage-related noise by zone

The percentage of respondents who indicated that garbage-related noises were a problem decreased for all types of garbage-related noise sources in the Commercial Core. The greatest percent change was with respect to the noise produced by garbage trucks backing up. **Even greater decreases occurred in the In-Between Zone**, which we did not initially expect. Here, the greatest percent decrease was in the percentage of respondents citing the noise generated by garbage trucks driving on the streets as a problem. For the most part, **the expected negative effects of increased garbage-related noise did not occur in the Spillover Zone**, where we thought they would. The exception to this was the perception of bothersome noise associated with garbage trucks driving on the street, which jumped by over 100 percent in the Spillover Zone. The most likely explanation for this is that trucks move through the Spillover Zone into the experimental area just a few minutes before 6 a.m., thus awakening those who'd otherwise have slept until at least 6 a.m.

Garbage-related noise by time

Figure E.6 shows that on weekdays, before the experimental program, **the largest percentage of respondents (62 percent) reported bothersome noise occurring in the morning hours, between 6 a.m. and 10 a.m. This decreased, as expected, to 55 percent.** The percentage of those reporting bothersome noise during the rest of the day increased for the most part, also as expected. There was also **an unexpected 15-percent *increase* in the percentage of people reporting weekday noise as bothersome between the hours of 2 a.m. and 6 a.m.; again, this may be due to the fact that the garbage collection started resumed right at 6 a.m.**, awakening people before they wanted to awaken.

Results were similar for the weekend. The most noticeable difference between weekends and weekdays is that on the weekends, noise is reportedly more bothersome between 10 p.m. and 2 a.m. and less bothersome during the morning hours of 2 a.m. to 10 a.m. This is likely due to the higher nighttime activity levels along Northwest 21st and 23rd avenues on the weekends, combined with less early-morning activity, including garbage collection.

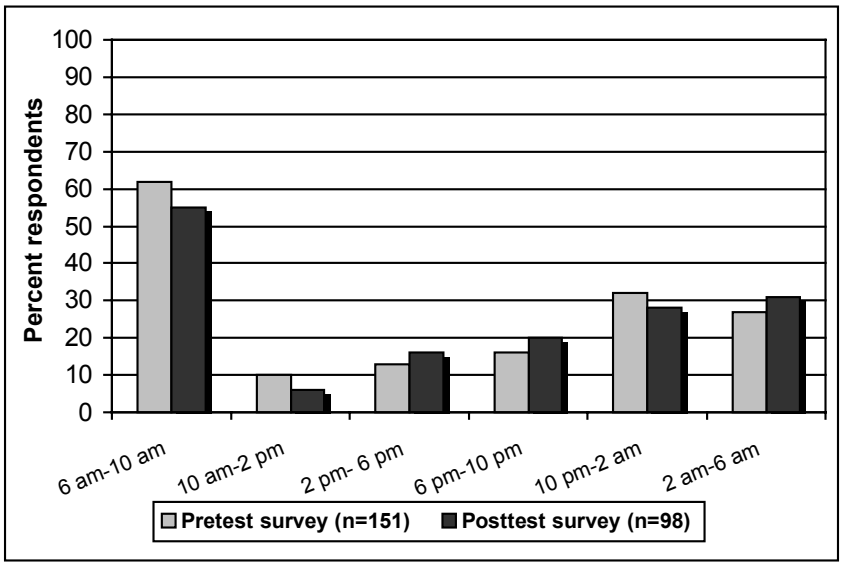


Figure E.6. Percent of residents reporting that noise has been the most bothersome over the past two weeks during various four-hour blocks, weekdays only. (Source: Northwest Livability Study, PSU 1999).

Sleep-disturbing noise

Frequency of "sleep-disturbing" noise

As Figure E.7 reveals, nearly all residents surveyed both before and during the experimental program reported that their sleep had been disturbed at least once. **About 40 percent indicated that their sleep had been disturbed by outside noise two to three times over the past two weeks.** This contrasts with a 1977 study that revealed that, nationwide, only 21 percent of respondents reported having been annoyed from sleep disturbance caused by neighborhood noise.[2] That study found a correlation between higher levels of sleep disturbance by noise and population density; our findings confirm this correlation, with Northwest Portland having among the highest densities in the state.

Figure E.7 does not reveal variations by zone. When these are examined, we find that **the most dramatic shifts detected during the experimental program occurred in the In-Between Zone, where reports of disturbed sleep were less frequent during the experimental program, and in the Spillover Zone, where reports of disturbed sleep were more frequent.** These shifts were both in the anticipated direction. Reports of sleep-disturbing noise by Commercial Core residents remained relatively constant. One explanation for this is, again, that the 6 a.m. cutoff may not have been late enough for these residents.

[2] US Environmental Protection Agency, Office of Noise Abatement and Control, "Report Under Contract No. 68-01-4184" (Washington, DC, 1977), p. 30.

Sources of "sleep-disturbing" noise

Table E.2 shows that **noise from garbage collection and dumping and from recycling collection—two of the top three sources of sleep-disturbing noise identified before the experimental program—both became less important sources of sleep-disturbing noise during the experimental program.** These findings suggest that although trucks driving on streets was cited as a major source of *bothersome* noise, it is not as important a source of *sleep-disturbing* noise as are garbage and recycling dumping and collection. This is in line with what we know about the higher decibel and frequency levels and impulse-intermittent nature of dumping and collection, compared with that of trucks driving.

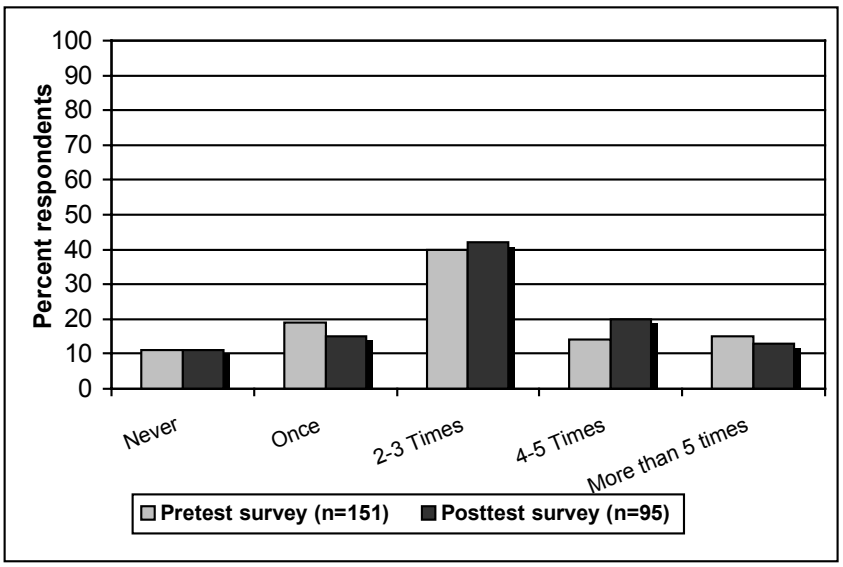


Figure E.7. Percent of residents reporting the number of times they had had their sleep disturbed by noise outside their home over the past two weeks. (Source: Northwest Livability Study, PSU 1999).

Table E.2. Ranking of factors identified by residents as a top three source of sleep-disturbing noise over the past two weeks. *Factors that fell in rank* o *are indicated in bold italics.* (Source: Northwest Livability Survey, PSU 1999).

Source of sleep-disturbing noise	Ranking Pretest	Ranking Posttest
Loud people outside	1	1 *n.c.*
Garbage collection/dumping	***1***	***2*** o
Recycling collection (glass, etc.)	***3***	***5*** o
Anti-theft alarms	4	3 ρ
Traffic in neighborhood	5	4 ρ
Construction noise	***6***	***11*** o
Homeless people making noise	***7***	***8*** o
Garbage trucks backing up	8	7 ρ
Noisy neighbors	9	5 ρ
Buses	***10***	***12*** o
Delivery trucks	11	8 ρ
Garbage trucks driving on street	12	10 ρ
Other	***12***	***13*** o
Industrial noise	14	13 ρ
Freeway noise	15	13 ρ

Neighborhood noise scale

Table E.3. Neighborhood noise scale. (Source: Northwest Livability Survey, PSU 1999).

0	2	4	6	8	10
A calm, very quiet place	Activity and noise of a quiet residential area	Usually quiet, with some busy times	Lively	A noisy, bustling, active place	Too noisy, too much activity

The survey asked people to rate the noise level where they live, the noise level they believe the "average person" would want to live, and the "ideal" noise level where they would like to live. The scale, shown in Table E.3, ranged from 0 (a calm, very quiet place) to 10 (too noisy, too much activity). **For 82 percent of the respondents, the noise level of the ideal place to live is between 0 and 5, whereas for approximately the same percent, the noise level where they presently live is between 4 and 10.** In fact, 25 percent said the area where they presently live is in the 8 to 10 range ("a noisy, bustling, active place" to "too noisy, too much activity").

Suggestions for improving the noise situation

The survey asked residents, in an open-ended question, to provide suggestions for improving the noise situation. **The most common suggestion was to restrict all loud noises before 7 or 8 a.m. Many residents specifically suggested restricting garbage collection before these times.**

Findings with Respect to Spillover Implications

We looked at four types of unintended negative consequences that might have resulted from the experimental program. These were increased garbage collection noise in the Spillover Zone; increased traffic throughout the area during peak commute times; increased disruption to businesses, both in terms of noise and traffic; and the potential of increased prices passed on to consumers because haulers might face increased costs.

Increased perceptions of garbage-related noise did *not* occur where we thought they would. In fact, the percentage of Spillover Zone respondents citing noise as a problem decreased for all garbage-related activities *except* garbage trucks driving on the street. As we've noted, the most likely explanation for this is that trucks are likely to have been passing through the Spillover Zone in the minutes right before 6 a.m.

There **was *no difference* in perceptions of traffic congestion among residents surveyed before and during the experimental program.** Both before and during the experiment, the two most frequently cited sources of traffic congestion were the construction of the Central City Streetcar and the closure of the Lovejoy Ramp.

Among business owners, noise in general is not a high-priority concern. During the experimental program, there was an increase in concern over garbage collection noise from businesses outside of the Commercial Core, but the increase was very small.

The effect that a permanent time restriction on commercial garbage collection might have on both residential and commercial collection costs and, hence, increased prices for the consumer was not assessed, but remains an important policy consideration.

Findings with Respect to Sociodemographic Implications

In general, the residents responding to this survey appear to be representative of the overall population in Northwest Portland, especially compared with respondents to other surveys of this type. The majority are younger adults (18 to 45), with at least some post high school education (although survey respondents were more likely than the population to have a graduate or professional degree). Respondents do tend to have higher incomes than the population overall, and they are somewhat more likely to be homeowners.

In line with previous research, our findings show that there is a relationship between density and noise annoyance: **residents who live in denser areas are more likely to report noise as a problem** (see Table E.4). Also in line with other research, our results suggest that **those who rate their neighborhood worse than other neighborhoods are far more likely to consider noise a problem** than those who rate their neighborhood as better than or the same as other neighborhoods (see Table E.5). Finally, although some research suggests that the harmful

effects of noise may be mores severe for older adults, such research also suggests—as does ours—that **younger adults are more likely to report being bothered by noise than are older adults**, the majority of whom indicated it was either not a problem or, at worst, an inconvenience.

Table E.4. Density of residential zone by respondents' perception of noise as a problem (Source: Northwest Livability Survey, PSU 1999.)

Density \ Perception of Noise	Noise is Not a Problem	Noise is an Inconvenience	Noise is a Problem	Total Percent
Commercial Core, Commercial Periphery, and Spillover Zones (highest densities)	19%	40%	41%	100%
In-Between Zone (lower densities)	42%	40%	18%	100%
Total count	70	122	144	306

Table E.5. Perception of Northwest compared with other neighborhoods by respondents' perception of noise as a problem (Source: Northwest Livability Survey, PSU 1999.)

Perception of Northwest as a Place to Live \ Perception of Noise	Noise is Not a Problem	Noise is an Inconvenience	Noise is a Problem	Total Percent
Better than other neighborhoods	22%	42%	36%	100%
Same as other neighborhoods	32%	35%	33%	100%
Worse than other neighborhoods	0%	21%	79%	100%
Total count	65	118	112	295

Conclusions and Policy Implications

As in our 1994 study, we found that, although residents of Northwest continue to have a high degree of satisfaction with their neighborhood, the lack of parking remains a primary problem for Northwest residents. Crime and traffic also detract from the neighborhood's appeal. It is important for residents and policy-makers to keep in mind that while people do consider various sources of urban noise to be bothersome, they still tend to rank the lack of parking, crime, and traffic as more bothersome.

Noise pollution, unlike air or water pollution, does not lead to catastrophic (i.e., life-threatening) health problems. It can, however, cause or exacerbate noncatastrophic health problems, including cardiovascular disease, loss of hearing, and increased stress—particularly due to lack of sleep. In many ways, it is a more apparent indicator of quality of life than other types of pollution, because its bothersome effects are immediate.

When we controlled for the other bothersome factors in the urban environment and focused only on noise, the four top sources of noise were anti-theft alarms, people outside talking or shouting,

garbage collection and dumping, and neighborhood traffic. During the experimental program, which altered the timing of garbage collection in this neighborhood, a smaller percentage of survey respondents cited garbage-related noise as a problem and a smaller percentage ranked garbage-related noise as a primary source of sleep disruption.

This study faced several challenges that make an interpretation of its findings subject to caution. In addition to the small sample size, the experimental design had garbage collection resume at 6 a.m. Several findings of our research suggest that this cutoff time was too early to have effects as profound as we might have seen with a 7 or 8 a.m. cutoff time.

Nevertheless, it is apparent that urban noise—unwanted sound in urban areas—continues to spread and increase in intensity. There are many sources of urban noise, and, like other types of pollution, the sources and the effects are difficult to control.

Many national governments have become involved in addressing urban noise pollution. In the United States, the federal government's involvement was short lived, from the early 1970s to 1981. This left the burden for noise abatement to local jurisdictions. But many local governments do not have the resources to measure and address noise.

Portland, Oregon, is typical of many U.S. cities in having few noise control enforcement resources. As the city continues to grow, however, residents and city leaders have begun calling for more research and more resources to control urban noise. This report, the second of its kind in less than a decade, as well as a recently formed Noise Mitigation Task Force, signal growing concern with formulating and enacting new noise control policy.

The challenges for policy formulation and implementation in the area of noise mitigation are great. As this report has indicated, some of the sources of the most annoying types of noise—antitheft alarms and loud people—may be difficult if not impossible to regulate. It may be possible, however, to regulate other sources of noise such as that generated by garbage collection, delivery trucks, and buses.

The most common method of addressing unwanted by-products of urban activities (i.e., negative externalities) is through taxation or regulation. The City could, for example, tax garbage haulers and private trucks when their activities exceed certain decibel limits. It is important for policy-makers to be aware of the political costs of such a policy. In many cases, the costs of taxation or regulation may be borne by the end user—the customer or apartment dweller—in the form of higher prices and rents.

A cooperative, consensus-based approach to mitigation is more effective over the long term than a punitive or adversarial approach, which often results in enforcement through litigation, an expensive and inefficient means of implementation. The fact that urban noise complaints in the Portland area are frequently generated by residents of high-density, mixed use neighborhoods further underscores the importance of a cooperate, consensus-based approach. The City of Portland, in line with regional and state planning objectives, has embraced a goal of central city densification and mixing of land uses. While this type of development may have many positive impacts, it has also been shown to result in an intensification of other disamenities—noise pollution among them.

The challenge, therefore, is for local policy-makers to balance their planning vision of increased density and mixed land uses with that of economic vitality. Northwest Portland is an excellent example of a neighborhood that thrives precisely because it has density and mixed land uses. There is a symbiotic relationship between the residents and the businesses in the area, but this

relationship is increasingly precarious. The needs and demands of the residents conflict with the needs and demands not only of businesses but of other residents in the area.

Through collaborative dialogue, the parties involved (residents, garbage haulers, city officials) can negotiate compromise and cooperation, rather than risk the political fallout of top-down, adversarial punitive regulation and/or taxation. The potential parties in this process have already demonstrated their willingness and ability to work together in this fashion, through the creation of the steering committee that brought about the present study.

It is crucial that if the public and the City choose to address urban noise, the City establish a cooperative, consensus-based framework for doing so, not just to address problems with noise that currently exist, but those that are bound to intensify in the future as the city and the region grow.

In conclusion, the findings of this research suggest that changing the time of garbage collection in mixed-use areas such as Northwest Portland so that it is prohibited between at least 10 p.m. and 6 a.m., if not 7 or 8 a.m., is very likely to improve the quality of life associated with garbage-related noise. We know that garbage-collection noise is annoying—profoundly so—for some residents in Northwest Portland. Whether this noise profoundly annoys a significant enough percentage of the residents to warrant governmental intervention is a question that this report cannot answer. However, we know that urban noise pollution, from a variety of sources, is likely only to worsen as densities and mixing of land uses increase. It is important to remember, though, that other problems associated with dense urban living are equally likely to worsen and that the public may consider some of these as even greater problems than noise. It is for the public and policy-makers to prioritize the targets of problem solving.

FINAL REPORT

Evaluation of Livability in Northwest Portland:

Noise and Other Nuisances in a High-Density, Mixed-Use Neighborhood

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Final Report

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For the City of Portland

Bureau of Environmental Services

Chapter 1

Introduction

➪ Chapter summary

The purpose of this study is to assess the effect of an experimental program to restrict the timing of garbage and recycling collection in the high-density, mixed-use district of Northwest Portland, with an emphasis on how the experimental restrictions affected the perception of noise by neighborhood residents and businesses.

Noise in a close urban setting emanates from many sources, most of which are unavoidable features of the city: emergency vehicle sirens; automobile alarms; traffic, including large vehicles such as delivery trucks and garbage haulers; music and conversation associated with entertainment venues; the activities and conversation of neighbors, visitors, and businesses; and police, tourist, and news helicopters.

One common definition of noise is "unwanted sound." Important characteristics of sound include its level (measured in decibels–dB), averages of its energy over time, duration, and frequency. The Environmental Protection Agency (EPA) has determined that a safe day-night average sound level is 55 dB. This is about the equivalent of normal, quiet conversation. The loudest natural sound on earth – thunderclap – registers 120 dB. Most sounds associated with garbage and recycling collection are 75 or 80 dB at minimum. In addition, many of these sounds are "impulsive" and "intermittent," which makes them more annoying because of their unpredictability.

In the 1970s, the EPA became concerned with urban noise, and state and local governments received funding for noise abatement. Such programs were eliminated in 1981. At present, Portland's City Code prohibits nighttime noise ranging from 50 dB in residential areas to 65 dB in commercial areas. Impulse sounds are limited to 80 dB at their peak during the night. Portland's Noise Control Office is staffed by one person, who investigates noise complaints. Police officers also field noise complaints, as does the Bureau of Environmental Services (BES), which regulates the city's garbage and recycling collection.

Through administrative rules, BES prohibits residential garbage and recycling collection between 10 p.m. and 6 a.m. Commercial garbage and recycling collection is not regulated, except in the core of downtown, where it must occur during the nighttime hours. Garbage and recycling collection in mixed-use areas like Northwest Portland presents a particular problem. These areas may contain both commercial and residential buildings in close proximity to one another. Because there is no restriction on the timing of commercial collection, much of it does in fact tend to occur in the nighttime hours. Residents of mixed-use areas may be disturbed by commercial nighttime collection occurring one building or one block down the street. In Portland, this noise may occur at any time of the night, including the early-morning hours of 2 a.m. to 6 a.m. Sleep disruption during this time period may be particularly deleterious, because this is when the lightest sleep phase occurs. Rapid eye movement, body movements, cardiovascular responses, and next-day performance quality and mood may all be adversely affected. Effects are more severe in the elderly.

Northwest Portland has an active neighborhood association, the Northwest District Association (NWDA), which has been increasingly concerned with urban noise as the neighborhood develops rapidly into a mixed-use activity center, tourist destination, home to many multi- and single-family residents, and the densest area in the entire state. The effect of urban noise on the quality of life in Northwest Portland is the focus of this report.

Objectives

The purpose of this study is to assess the effect of an experimental program to restrict the timing of garbage and recycling collection in the high-density, mixed-use district of Northwest Portland. In particular, this study looks at how the experimental restrictions affected the perception of noise by neighborhood residents and businesses, as well as any negative spillover effects, such as increased traffic during rush hour and increased collection noise in adjacent neighborhoods not subject to the restrictions.

The City of Portland initiated this study in response to complaints the City received regarding garbage collection noise—particularly early-morning garbage collection—in Northwest Portland. The City and Portland State University's interest lies not only assessing the perception of noise levels in Northwest Portland, but also in the implications for similar high-density, mixed-use neighborhoods—existing or planned—throughout the City.

Residents of dense, mixed-use neighborhoods such as Northwest Portland benefit from a number of amenities not found in lower density, residential neighborhoods: access to restaurants, shops, services and other resources, convenient transit service, the excitement of an urban atmosphere, etc. These benefits, however, often come at a cost: increased traffic, parking problems, noise pollution, and "outsiders" using the area. As the City continues to support the development of commercial clusters within residential neighborhoods and the densification of existing mixed-use areas, it is necessary to understand the implications such development will have on all aspects of neighborhood livability, including urban noise.

This report evaluates changes in how residents' perceptions of noise changed during an experimental program to restrict late-night and early-morning commercial garbage and recycling collection in Northwest Portland. It also looks at the implications of these restrictions for traffic, parking, local businesses, and the adjacent Pearl District—a warehouse district currently in the process of revitalization as another high-density, mixed-use neighborhood.

Background

Urban noise

High-density, mixed-use urban neighborhoods offer many amenities to their inhabitants—a vibrant environment, diversity, easy access to shops and employment—but scholars and policy-makers have long been aware of the potential disamenities associated with urban life, including traffic congestion, crime, homelessness, and noise.

Noise in a close urban setting emanates from many sources, most of which are unavoidable features of the city: emergency vehicle sirens; automobile alarms; traffic, including large vehicles such as delivery trucks and garbage haulers; music and conversation associated with entertainment venues; the activities and conversation of neighbors, visitors, and businesses; and police, tourist, and news helicopters.

Defining "noise"

One common definition of noise is "unwanted sound."[3] There are several important characteristics of sound to take into consideration in assessing its potential to create bothersome noise.

One characteristic is the amplitude of the **sound level**, which is measured in decibels (dB). Quiet breathing registers 10 dB, while quiet conversation weighs in at about 60 dB. Someone shouting across the room would be equivalent to around 75 dB. The sound of midtown traffic in New York City would register anywhere between 80 to 95 dB. An express subway train rumbles through a local station at 105 dB. The sound of a jet taking off comes in at 120 dB. This is also the dB rating of the loudest natural sound on earth: thunderclap.[4]

In terms of disruptiveness, 40 dB will awaken sound-sensitive people and "light sleepers." Almost anyone will be awoken by a sound registering 70 dB. Beyond this, sounds at 120 dB will cause discomfort and sometimes even injury, while a sound registering at 140 dB (a rock band, with amplifiers and loudspeakers turned up) can be acutely painful.[5]

Another characteristic of noise is **averages of sound energy over a period of time**. The Environmental Protection Agency (EPA) and other sources incorporate a 10-dB "penalty" for sounds from 10 p.m. to 7 a.m., which means that they count sounds occurring in that time period as 10 dB higher than they really are. The day-night average sound level is referred to as DNL. In 1974, the EPA identified a safe DNL of 55 dB. At that time, nearly 100 million Americans were already living in areas where the DNL exceeded the EPA's safe level.[6]

Another important characteristic of noise is its **duration** and the way that it is distributed over time. There are four types of temporal distributions: continuous, varying, intermittent, and impulsive. The **frequency** of a sound compounds temporal distributions. Continuous, low-frequency sound such as the indoor sound of air-conditioning is the least annoying and least damaging. High-frequency sounds, particularly when continuous, such as a continuous high-pitched car alarm, are the most hazardous to hearing and are also very annoying.[7]

Intermittent sounds, which are sounds that are interspersed with quiet periods, and **impulsive sounds**, which are loud sounds with short durations, are often the most *annoying* sounds, because of their unpredictability.[8] Many urban sounds fall into these categories.

In the early 1970s, the EPA began investigating the impacts of urban noise, or noise pollution, among the other types of pollution affecting urban dwellers. These and subsequent investigations have found that while loud, unwanted urban noise has little catastrophic effect on human health (unlike, for instance, air pollution), it does have very

[3] Alice J. Suter, "Noise and Its Effects," presented at the Administrative Conference of the United States, 1991. p. 3.
[4] Julia Vitullo-Martin, "Quiet, Please," *City Journal*, 1994, Vol. 4, No. 4, pp. 46-54.
[5] Ibid.
[6] Suter, p. 4, 9.
[7] Ibid., p. 3.
[8] Ibid.

profound effects on the quality of life, defined by both physiological and psychological variables. These include effects on the cardiovascular system, such as increased blood pressure; increased stress, including the release of adrenalin similar to the "flight or fight" response; and sleep disturbance.

Regulation of urban noise

As noted above, during the 1970s, the federal government became involved with noise abatement through the EPA's Office of Noise Abatement and Control. In fact, during the 1970s, all three levels of government—federal, state, and local—became active in noise abatement. However, in 1981, the federal program was eliminated, "resulting," as Terry Obteska, Manger of the Noise Control Program of the Air Quality Division of Oregon's Department of Environmental Quality, put it, "in the wholesale death of state and local programs…"[9]

Presently, at the local level in Portland, there are two laws that govern noise. Title 18 of the municipal code sets rules and regulations and some specific sound levels. Title 18 is the policy framework that the city's Noise Review Board and Noise Control Office use. For example, it defines "night hours" in Portland as between 10 p.m. and 7 a.m., consistent with most sources.[10] It recognizes a nighttime "penalty" of 5 dB, rather than 10.[11] It also recognizes the particular annoyance of impulse sound, prohibiting impulse sounds greater than 100 dB at their peak sound during the day and 80 dB during the night. This title also provides tables for permissible dB levels. In residential and commercial areas, the maximum sound level is 70 dB (for sound generated in a commercial area and received in a commercial area), while the minimum is 55 dB (for sound generated in a residential area and received in a residential area).[12] With a nighttime penalty of 5 dB, these ranges would drop to 50 to 65 dB.

Portland's Noise Control Office is staffed by one person, Paul van Orden, who has been the city's Noise Control Officer for ten years. Van Orden's office receives between 15 and 22 noise-complaint calls per day, with the higher number representing summertime. It is not possible for van Orden, and, during the summertime, an assistant, to keep up with the number of cases, and so there is always a backlog.[13]

This backlog is one reason why the city's residents also voice their sound-related complaints to other city bureaus, including the Bureau of Police. Title 14 of the City Code allows police officers to make a subjective assessment regarding "any excessive or unusually loud sound which disturbs the peace and quiet of any neighborhood or which does injury or endanger the comfort, repose, health, peace, or safety of any person."[14]

Until recently, noise control has not been as much of a priority for the City of Portland as it has been for some other municipalities, despite increasing complaints regarding urban noise, particularly in high-density, mixed-use neighborhoods such as Northwest Portland. While the City's Noise Control Office reports "top offenders" in noise violations to be

[9] Sidney Shapiro, "The Dormant Noise Control Act and Options to Abate Noise Pollution," prepared for the Administrative Conference of the United States, 1991, p. 26.
[10] City of Portland, Code, as amended through May 18, 1994, Title 18.10.010.
[11] Ibid., Title 18.10.010 (B)(1).
[12] Ibid., Title 18.20.010, Figure 1.
[13] Roger Anthony, "City's Noise is Catching Many Ears," *The Oregonian*, 17 July 2000.
[14] City of Portland, Code, Title 17.102.100 Reserved.17.102.110.

"power tools, air-conditioning and heating units, garbage trucks and industrial racket,"[15] air traffic noise, both at the airport and downtown (in the form of news and other types of helicopters), is also a problem. Noise emanating from air traffic is not the domain of the City's Noise Control Office, however, falling instead under the jurisdiction of the Federal Aviation Administration.[16] Another source of noise complaints is the noise associated with liquor-serving establishments, especially in mixed-use areas: both the noise within the establishment (music, for example) and the noise of patrons as they exit and enter the establishment.[17]

In July of 2000, the Portland City Council established a Noise Mitigation Task Force. The findings of this task force may result in amendments to or adoption of new ordinances and administrative rules concerning noise. One impetus behind the creation of this task force is the persistence of complaints regarding garbage-collection noise in high-density, mixed-use neighborhoods. Citizens often make these complaints directly to the city's Bureau of Environmental Services (BES), which regulates the city's refuse and recycling collection. The BES is also responsible for commissioning this report, which will now turn to an overview of refuse and recycling regulations and noise issues in Portland.

Refuse and recycling in Portland

In the Portland metropolitan region, individual jurisdictions regulate garbage and recycling collection. The jurisdictions may regulate residential collection differently from commercial collection. For the city of Portland, Title 17 of the City Code regulates solid waste and recycling collection. The title gives the Director of the Bureau of Environmental Services (BES) authority to make administrative rules to implement the provisions of the title. These rules include provisions regarding collection times, which will be discussed later.

For residential refuse and recycling collection, Title 17 requires haulers to obtain a franchise. The City has assigned franchise territories to individual hauling companies, based on the number of customers each company had as of September 30, 1990. Through Title 17, the City regulates the price of residential refuse and recycling collection.[18]

Unlike other jurisdictions in this metropolitan area, the City of Portland does not franchise commercial collection. There is, instead, an open and competitive system for the provision of commercial garbage and recycling collection, although commercial collection companies must obtain a permit from the City. As a result, multiple service providers can and do provide commercial collection services in Northwest Portland, with many trucks in the area seven days a week. Pricing is competitive.

Garbage and recycling noise

Refuse and recycling collection activities generate a variety of different sounds that most people would consider "noise" (unwanted sound). The sound of the collection vehicle

[15] Robin Franzen, "As Portland Grows, So Do Noise Complaints," *The Oregonian*. 22 August 1999, p. B01.
[16] Anthony.
[17] Martha J., Bianco, Judy S. Davis, and Vicky Lovell, "Neighborhood Livability in Northwest Portland," report prepared for the City of Portland, Bureau of Licenses (Center for Urban Studies, Portland State University, 1994, No. PR081).
[18] City of Portland, Code, Title 14.24.150.

driving on the street, like that of other heavy trucks, is likely to register at least 75 dB—the same as a passing bus.[19] A compactor will register at least 80 dB at 50 feet from the site.[20] Other sounds, including handling of refuse containers (especially metal), dumping of refuse, and dumping of glass and metal recyclables all register higher. In addition, all of these types of garbage- and recycling-related sounds can be considered intermittent or impulse sounds—the most annoying of all.

BES's administrative rules regarding residential and commercial garbage and recycling prohibit the collection of garbage or recycling at multifamily units, such as apartment buildings, between 10 p.m. and 6 a.m. The rules prohibit collection in single-family residential areas between 5 p.m. and 6 a.m. Thus, in both cases, collection may begin as early as 6 a.m. There is no prohibition on the time for commercial collection. Title 14 of the City Code does prohibit collection in the downtown core between 10 a.m. and 10 p.m.; thus, collection in downtown Portland must occur during the night.[21]

The primary problem emerging from garbage and recycling collection noise is related to the timing of collection. As noted above, garbage collection noises are unlikely to fall below 75 dB, and as noted earlier, almost anyone will be awoken by 70 dB. Thus, any garbage collection occurring during nighttime or early-morning hours is likely to cause sleep disruption. For this reason, collection is prohibited in residential areas until 6 a.m. Even that may be too early for those who prefer to sleep until 7 a.m. In these cases, noise-induced sleep disruption tends to be greater than if it were to occur in the middle of the night, because in the early morning (e.g., 4 a.m. to 6 a.m.), individuals spend more time in lighter sleep stages accompanied by rapid eye movement (REM). The elderly are particularly sensitive to noise-induced sleep disruption in the early morning.[22]

Mixed-use areas present a particular problem. These areas may contain both commercial and residential—especially multifamily—buildings in close proximity to one another. Because there is no restriction on the timing of commercial collection, much of it does in fact tend to occur in the nighttime hours, when haulers do not have to contend with very much traffic. Residents of mixed-use areas may then be disturbed by commercial nighttime collection occurring one building or one block down the street. In Portland, this noise may occur at any time of the night, including the early-morning hours of 2 a.m. to 6 a.m. Garbage collection noise may awaken sleepers at any time of the night. Even if sleepers return to sleep, their sleep cycles may be disrupted, causing changes from heavier to lighter stages, reductions in REM sleep, increases in body movements, and changes in cardiovascular responses. Individuals may not even recall being awoken, but instead report having had a "bad night's sleep" or changes in mood or performance quality the following day.[23] Again, the disruption tends to be more pronounced for those who are awoken in the early hours of the morning. Thus, even someone who has an alarm set for 6 a.m. may be awoken at 5 a.m. by garbage collection noise in a mixed-use neighborhood. Because this disruption is occurring during the lightest sleep phase, its deleterious effects are likely to be profound.

Because Northwest Portland is a neighborhood containing several large areas of intense mixed-use activity and development and because the neighborhood is among the densest in the entire state, urban noise has concerned its residents for decades. As the

[19] Franzen.
[20] Commonwealth of Massachusetts, Section 721.560: Construction Noise Control, Table 2.
[21] City of Portland, Code, Title 14.20.110.
[22] Suter, p. 20-21.
[23] Ibid., p. 20.

neighborhood becomes more diverse and more dense, this concern has increased. Before moving on to a description of this study's methodology and findings with respect to noise—particularly garbage-related noise—this report will provide some historical and descriptive context about Northwest Portland.

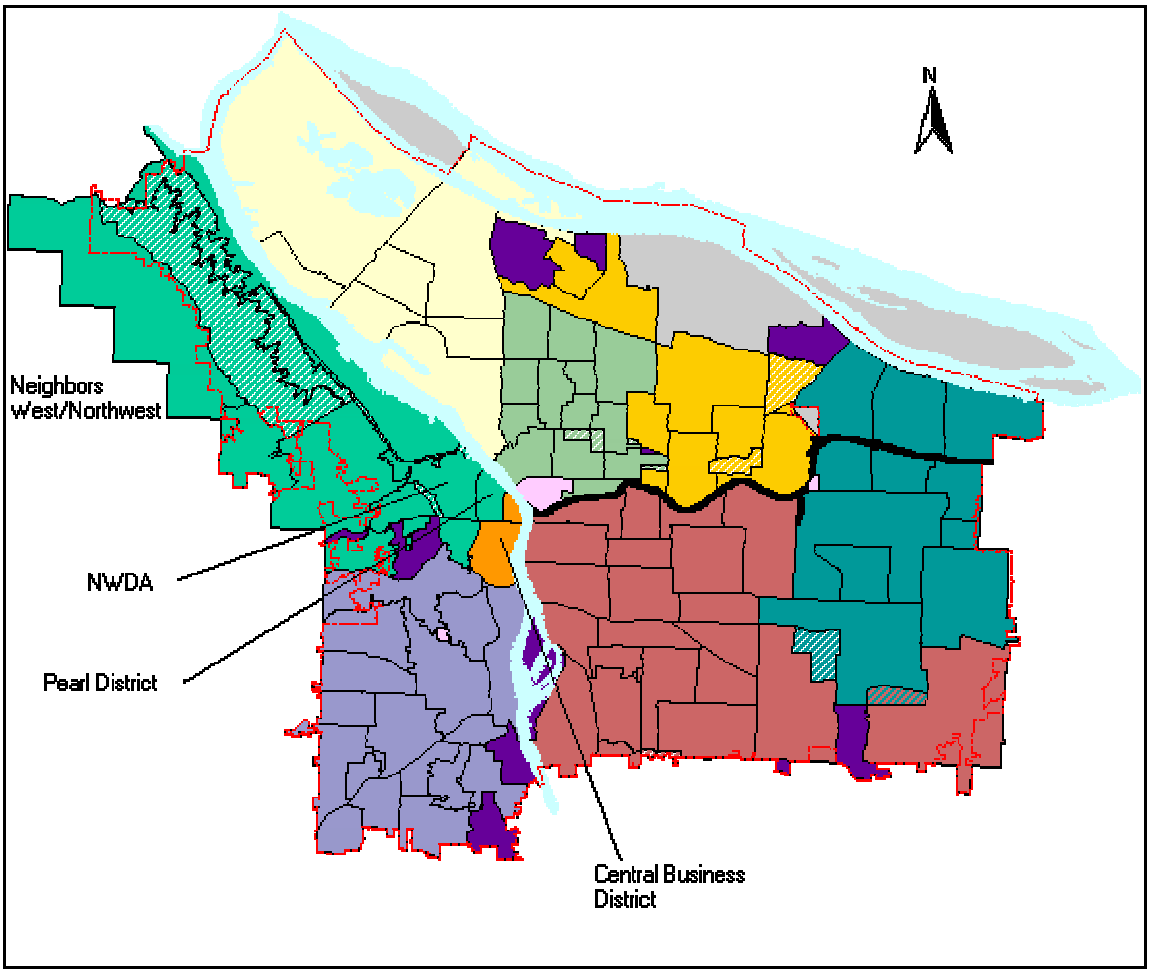
The Northwest Portland neighborhood

The central city of Portland, Oregon, consists of over a hundred individual neighborhood associations, comprising seven neighborhood district coalitions (see Map 1.1). The Neighbors West/Northwest Coalition consists of ten neighborhood associations, including the high-density, mixed-use Northwest District Association (NWDA). For the purposes of this study, the term "Northwest Portland" refers to the geographical area represented by the NWDA. As the map suggests, Northwest Portland is very close to downtown Portland, separated only by the Pearl District, a revitalizing warehouse district also containing mixed use and increasing density. A freeway separates Northwest and the Pearl District. The core of the Northwest District is within a mile of the core of the Pearl District and within another half mile to the core of the city center. Immediately to the north of the District is an industrial area, while to the west is sparsely populated Forest Park. Also to the west and southwest are the more densely populated single-family homes of the upper-income heights.

Although Northwest has been a close-in, high-density residential area with a strong core of commercial activity for most of its history (spanning nearly one and a half centuries), its social environment has changed dramatically over the past few decades. During the early 1900s, the Northwest neighborhood functioned as one of Portland's many "stopover" neighborhoods for immigrant newcomers.[24] With some of the city's highest residential densities and the bulk of its apartment buildings, immigrants moved to these neighborhoods temporarily as they became established in the area, moving out as soon as they could afford a better home. This pattern of use resulted in a high level of poverty relative to other Portland neighborhoods, and in a 1944 measure of social status and real estate values, Northwest Portland rated below average for the city in terms of social quality.[25]

In 1969, neighborhood activists formed the Northwest District Association (NWDA)—in response to a proposed urban renewal plan—and joined the rest of the City in a "neighborhood movement" aimed at improving conditions in Portland's inner neighborhoods.[26] Efforts in Northwest Portland were directed largely at protecting existing residential neighborhoods from encroaching commercial and institutional uses, as well as a proposed highway that would have cut through the area. During the early 1970s, the NWDA conducted a neighborhood planning process and, in 1975, the Portland City Council adopted the Northwest District Policy Plan.

[24] Carl Abbott, *Portland: Planning, Politics, and Growth in a Twentieth-Century City* (University of Nebraska Press: Lincoln and London, 1983).
[25] Ibid.
[26] Ibid.



Map 1.1. Portland central city with its seven neighborhood coalitions, including the Neighbors West/Northwest Coalition, consisting of ten neighborhoods, in the northwest quadrant. The study areas of the Northwest District Association (NWDA) and the Pearl District are indicated. (Source: City of Portland Planning Bureau, Metro RLIS[27]).

The goals of the plan "included expectations of a highly urban neighborhood with a diverse population living in 'a wide variety of…housing at all prices and rent levels' and supported a mixture of land uses that would contribute to a diversity of life styles and a stimulating environment."[28] The NWDA has since played a critical role in directing commercial activities and preserving historic buildings. By the late 1980s, the Northwest neighborhood, with its historic character and urban environment, began attracting "a mix of

[27] From Portland Neighborhood Coalitions webpage, accessed on 26 August 2000, at <http://duck.co.multnomah.or.us/pmpb/toppage.cfm>.
[28] Abbott, *Portland*, p. 198.

the elderly, students, second generation immigrants, and younger professionals, [making it] Portland's most cosmopolitan neighborhood."[29]

Since 1990, the activity of the commercial district has intensified, now drawing visitors and shoppers from a much larger geographic area than the surrounding neighborhoods. This intensification of commercial activity has created a number of problems resulting from the tensions between the high-density residential areas and the commercial areas. Urban noise, the general subject of this report, is one of these problems. When this study was commissioned, one particular noise source of concern to the City and neighborhood residents and business owners was garbage and recycling activity. This issue is therefore the focus of the present report. In 1994, however, a noise source of special concern was that associated with liquor-dispensing establishments (e.g., bars and restaurants). The resulting 1994 study, similar to the present one, is described briefly below.

The 1994 livability study

In 1994, the NWDA and the City of Portland's Bureau of Licenses—the agency responsible for issuing liquor licenses—contracted with Portland State University to investigate noise and other disamenities associated with the availability and consumption of alcohol in Northwest Portland. In response to concerns that local residents raised regarding late-night noise, loss of residential parking, and public inebriation, the 1994 study undertook to "assess the extent, strength and particulars of residents' and business owners' feelings about these alcohol-related issues, and, as much as possible, to separate out that part of these problems that [was] tied to alcohol use."[30]

The current study, although focused instead on noise issues related to garbage collection, is based on the 1994 survey. This serves two purposes. First, it minimizes the time and resources necessary for developing an entirely new survey instrument. Second, it allows us to make direct comparisons between 1994 and 1999 livability conditions. Where relevant throughout the report, we note the importance of changes in conditions from 1994 to the present.

In the next chapter, we provide a detailed overview of our methodology. In Chapter 3, we begin a discussion of our findings.

[29] Carl Abbott, "The Everyday City: Portland's Changing Neighborhoods," in Larry W. Price, *Portland's Changing Landscape* (Portland, Oregon: Portland State University Foundation,1987), p. 82.
[30] Bianco, Davis, and Lovell, p. 1.

Chapter 2

Study Methodology

➪ Chapter summary

In the fall of 1999, the City of Portland's Bureau of Environmental Studies (BES) implemented an experimental program to restrict commercial garbage- and recycling-collection times in an approximately one-square-mile section of Northwest Portland, where mixed land uses and densities are highest (the "experimental area"). The City prohibited garbage and recycling collection between the hours of 10 p.m. and 6 a.m., seven days per week, during the period from early September 1999 to the end of October 1999. The City contracted with Portland State University to evaluate the implications of this program. We administered a survey in two phases—one before (the "pretest") and one during the experimental program (the "posttest")—to evaluate the effects of the experimental program on perceptions of noise and other livability factors.

We based the 1999 survey on a previous survey we had administered in 1994. That survey included questions about livability that had been identified by focus group interviews we had conducted. We modified the 1999 survey to reflect the present emphasis on garbage-collection noise. As in the 1994 study, residents and business owners received similarly designed surveys. The surveys address five broad categories: general livability, noise, traffic, parking, and sociodemographic characteristics of the respondents.

After pilot testing the new survey, we randomly selected 650 residents and 150 businesses from a sampling frame of approximately 2630 residents and 1220 businesses provided by a commercial database supplier. We administered the pretest surveys by mail, approximately three weeks before the experimental program began, sending 600 of the residential surveys to the experimental area in Northwest Portland and 50 to the Pearl District, adjacent to Northwest, but outside the boundaries of the experimental program. We sent follow-up surveys to nonrespondents approximately two weeks after the initial mailing.

We sent out the pretest surveys on August 16 and a follow-up reminder on August 31. The experimental program began on September 6, 1999. To ensure that our pretest surveys captured only baseline conditions, we accepted no surveys postmarked after September 8. So that our posttest surveys would capture conditions present *during* the experimental program, we sent the posttest surveys out to another random sample of 650 residents and 50 businesses six weeks into the experimental program. We sent out reminder postcards to nonrespondents about ten days after the initial posttest mailing. The experimental program ended on October 31, 1999. We accepted no posttest surveys postmarked later than November 5.

Budget constraints, vacation season, and the fact that Northwest is a frequently studied area all account in part for the small resident response rate of 27 percent for the pretest and 19 percent for the posttest. Business rates were slightly lower: 19 percent for the pretest and 15 percent for the posttest.

We classified survey responses according to three geographic zones, which serve as the basis for our analysis of the data. Zone 1 is the Commercial Core, the area within 200 feet of the commercial corridors of Northwest 21st and 23rd avenues. We expected this zone to experience the most dramatic impacts of the experiment. Zone 2 is the In-Between Zone, the area immediately surrounding the Commercial Core. We expected less dramatic results here. Zone 3, the Spillover Zone, is the area outside of the Commercial Core and the In-Between Zone, extending 200 feet beyond the experimental area boundaries. We anticipated that these areas would experience some spillover impacts from the experimental program. This zone included the Pearl District.

In response to residents' complaints about garbage- and recycling-collection noise in Northwest Portland, in 1999 the City of Portland's Bureau of Environmental Services (BES) brought together a steering committee of local residents, business owners, garbage collectors, and representatives of other city bureaus to seek a solution. The committee decided to implement an experimental program to restrict commercial garbage- and recycling-collection times during the period from September 6, 1999, through October 31, 1999. The City contracted with Portland State University to assess the impacts of this program.

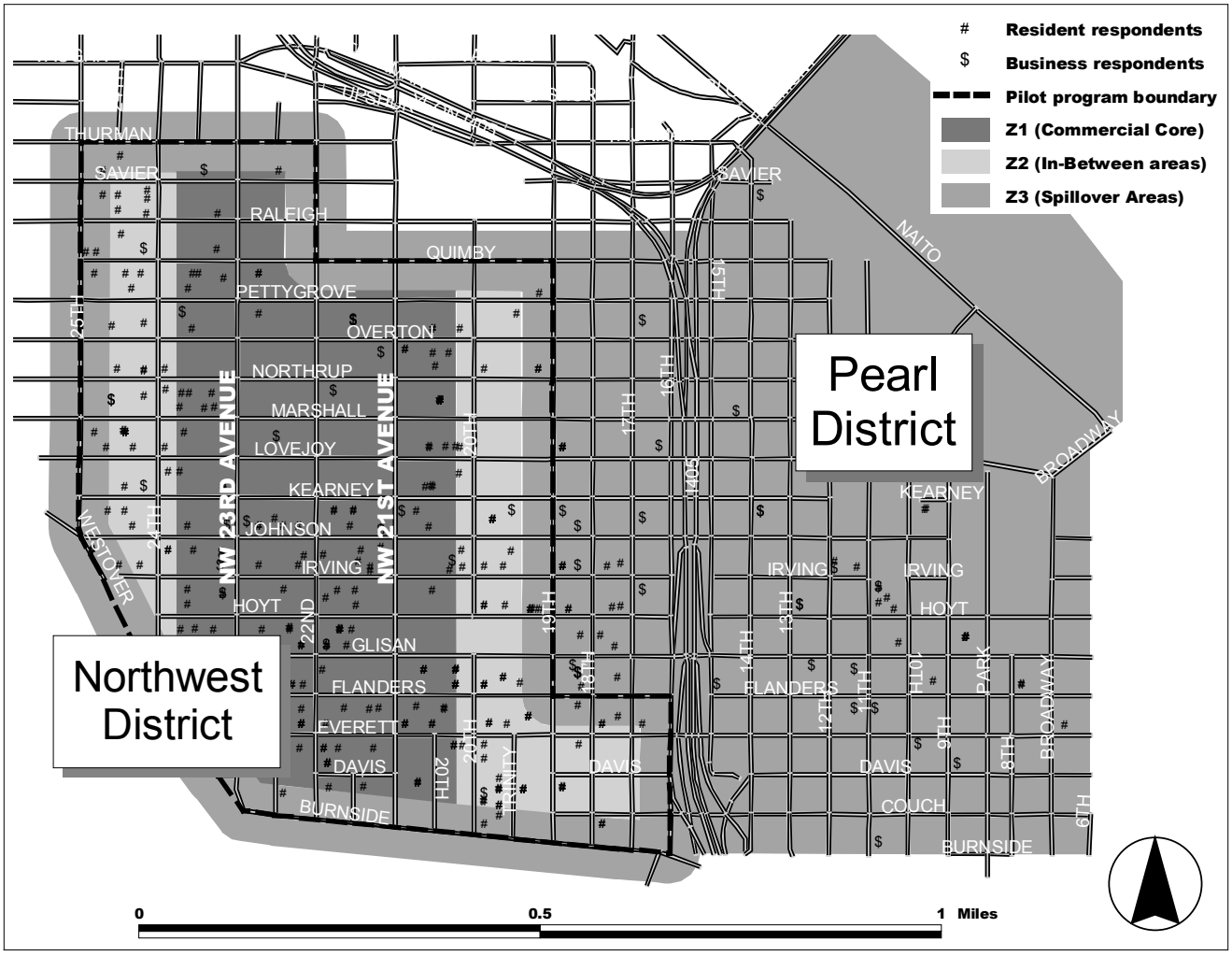
During the experimental program, the City limited the legal operating hours for commercial garbage and recycling collection within the geographic boundaries of the experimental area to the hours of 6 a.m. through 10 p.m., seven days a week. The boundaries of the experimental program area were West Burnside Street to the south, Northwest Thurman and Quimby streets to the north, Northwest 16th and 19th avenues to the east, and Westover Road and Northwest 25th Avenue to the west (see Map 2.1). We administered the survey in two phases—one before and one during the experimental program—to evaluate the effects of the experimental program on perceptions of noise and other livability factors.

Survey construction

This study builds on a similar survey Portland State University administered in 1994. The 1999 survey retained the basic structure and range of topics as in the previous survey, altering select questions to reflect the present focus on garbage-collection noise. As in the 1994 study, residents and business owners received similarly designed surveys. The surveys address five broad categories: general livability, noise, traffic, parking, and sociodemographic characteristics of the respondents. In each section, questions range from the general to the specific. The noise, traffic, and parking sections included open-ended sections to provide respondents the opportunity to make suggestions regarding how to improve any problems that they identified.

The 1999 study differs most importantly from the previous one in its design. Unlike the 1994 study, which used a single-observation, cross-sectional survey design, the 1999 study used a pretest-posttest experimental design. The purpose of the pretest survey was to provide a baseline by identifying residents' and businesses' perceptions of livability issues, including noise, prior to the experimental intervention of the change in garbage- and recycling-collection times. We administered the posttest survey toward the end of the eight-week experimental program to identify changes in perceptions of noise and other livability issues during the experimental intervention.

Prior to the administration of the pretest, we pilot tested the survey instrument on a small nonrandom sample of residents and business owners, whose names the Northwest Neighborhood Association provided. The final pretest survey instrument reflects the outcome of the pilot testing and the comments of the BES and members of a steering committee (see Appendix A for survey materials).



Map 2.1. The Northwest Neighborhood, by analysis zones. (Source: Portland State University).

Sampling frame

The population from which we randomly selected residents included all households within the study area, as shown by the shading on Map 2.1. The population for businesses included all businesses within the study area, except government offices and any part of Legacy Good Samaritan Hospital (the focus of this study is on commercial establishments). We used postal carrier routes to define the specific study area for the purpose of database creation. For the residential sampling frame, we obtained a residential database and for the business owner sampling frame, a businesses database from Database America, a provider of business and residential contact information.

The initial resident database contained 3399 records, and the initial business database contained 1921 records. We used geographical information system (GIS) software to address-match the records so that we could separate them by geographic zone for analysis. Because address-matching software is unable to assign all addresses, we discarded some of the records as invalid. The resulting databases, which constituted our sampling frames, contained 2634 resident records and 1219 business records.

Survey administration

We administered the survey by mail. Each subject, whether resident or business owner, received the survey, a cover letter, and a postage-paid return envelope (see Appendix A)

Table 2.1. Survey administration schedule, 1999.

Date	Task
Aug. 16	Pretest surveys mailed
Aug. 31	Follow-up pretest surveys mailed to nonrespondents
Sept. 6	Experimental program began
Sept. 8	Postmark deadline for pretest survey responses
Oct. 14	Posttest surveys mailed
Oct. 25	Follow-up posttest postcard reminders sent
Oct. 31	Experimental program ended

Pretest sampling and administration

On August 16, 1999, we sent pretest surveys to a random sample of 150 businesses and 650 residents (600 from the Northwest Neighborhood and 50 from the Pearl District to ensure representation from that rapidly developing district adjacent to Northwest, but

outside the boundaries of the experimental program).[31] To achieve the highest response rate possible under the circumstances of time constraints associated with the approaching start of the experimental program, we re-sent the full survey to all recipients who had not returned it within two weeks. We also drew an additional random sample of 55 residents and 30 businesses in an effort to maximize the return rate. To avoid confounding the analysis, we did not accept pretest survey responses postmarked after September 8, 1999—two days after the start of the experimental program. Because our questions that were specifically related to the before-and-after impacts of the experimental program had asked respondents to evaluate conditions during the *previous two weeks*, we did not feel that the two-day overlap (accepting surveys postmarked up to two days after the start of the program) would create any significant problem. See Table 2.1 for a summary of survey administration dates.

The greatest timing constraint associated with the pretest administration was the fact that although the City initiated this research project in late summer 1999, the experimental program restricting the timing of garbage and recycling collection had to occur as soon a possible, to avoid the confounding effects of cooler autumn weather (when people might be less likely to have their windows open). Another concern was that of late-summer vacationers; we anticipated low response rates because of the strong likelihood that people would be taking summer vacations prior to Labor Day, which was very close to the beginning of the experimental program.

Posttest sampling and administration

On October 14, 1999, we sent posttest surveys to another random sample of 650 residents (600 Northwest; 50 Pearl) and 150 businesses. The pretest and posttest sampling frames contained the same records, making it possible for someone to receive both the pre- and posttest survey. We sent follow-up postcard reminders to all posttest survey recipients who did not return the posttest survey within about ten days (seven business days) of the initial mailing. Again, we accepted no surveys postmarked more than two days after the end of the experimental program.

Response rates

Of the entire resident sample, 192 people returned the pretest survey (a 27-percent response rate) and 123 returned the posttest survey (a 19-percent response rate). Response rates for business proprietors were slightly lower: 19 percent (35 total responses) for the pretest, and 15 percent (23 total responses) for the posttest.

Data analysis

The target area for this study included the experimental program area and extended east to Northwest Sixth Avenue to capture any spillover effects in the form of increased traffic or noise in the Pearl District, a mixed-use area adjacent to the experimental program area. We classified survey responses according to three geographic categories, or zones, as illustrated in Map 2.1. These zones also serve as the basis for some of our analyses of the data.

[31] We always drew random samples with replacement to ensure a consistent probability of selection for all members of the sampling frames.

Zone 1, the **Commercial Core**, is the area within 200 feet of the commercial corridors of Northwest 21st and 23rd avenues. This zone also includes the area *between* Northwest 21st and 23rd, as we determined that the character of this area is similar to the character of the areas within 200 feet of these streets. We anticipated that commercial waste collection would strongly affect these areas, and we therefore expected these areas to experience the greatest direct impact from the experimental program.

Zone 2, the **In-Between Zone**, is the area immediately surrounding the Commercial Core. We anticipated that commercial waste collection would also affect residences and businesses within this zone, but to a lesser degree than in the Commercial Core. We therefore expected the effects of the experimental program to be in the same direction as in the Commercial Core, but less dramatic.

Zone 3, the **Spillover Zone**, is the area outside of the Commercial Core and the In-Between Zone, beyond 200 feet of the experimental area's outermost boundaries. We anticipated that these areas would receive some spillover impacts from the experimental program. This area includes the Pearl District, which as a mixed-use area, may experience problems similar to those of the Northwest Neighborhood commercial areas.

In terms of distribution, nearly half of all resident respondents (48 percent) live within the Commercial Core Zone. The remaining half is divided nearly equally between the In-Between Zone and the Spillover Zone (28 percent and 24 percent, respectively). This distribution allows us to be more confident in our analyses of Commercial Core residents, the primary focus of this study. Among business respondents, the majority (55 percent) operate their business within the Spillover Zone, followed by the Commercial Core (35 percent) and the In-Between areas (10 percent). Although we would have liked to have had more representation from the Commercial Core, we delineated the zones as described above to preserve the statistical integrity of the resident distribution.

Limitations of this research

As with any research, weaknesses can originate from both the methodology and the unique environment in which researchers conduct their study.

It is likely that recipients who completed and returned the survey differ, at least in some cases, from those who did not. This common *self-selection* bias means that, compared with nonrespondents, the respondents may have stronger opinions; they may be more comfortable with the survey techniques; they may have more time to fill out the survey; they may be particularly informed about the survey topic; or they may differ in other important ways. Thus, the survey results represent the opinions of the residents and business owners that chose to fill out and return the survey, and *not necessarily the neighborhood as a whole*. One way of observing the extent to which the actual respondents differ from the neighborhood as a whole is by comparing the personal information the respondents provided with a neighborhood profile that the Census Bureau prepared. As described in more detail in Chapter 6: "Findings with Respect to Sociodemographic Implications," survey respondents are more likely to be homeowners and to have higher incomes than the neighborhood as a whole. These differences, however, are not great; overall, the sample appears to be quite similar to the population as a whole.

Limitations also exist as a result of the *undesirably low response rate*. Four possible explanations for the low response rate include seasonal effects, frequent surveying in the neighborhood in general, high residential turnover, and the time limitations of the study. First, due to the desire to conduct the experimental program during the seasonable months of 1999, rather than delaying until the summer of 2000, we administered the pretest survey during the popular vacation months of August and September. Resident absence may have contributed to a low rate of response. Second, the Northwest neighborhoods are the subject of frequent study, which may have discouraged responses by residents and business owners. Third, a large percentage of returned mail due to outdated addresses, indicative of high turnover rate of residents in Northwest Portland and/or poor database quality, lowered the number of actual recipients. Finally, the fast-track timeline necessary for this project limited the extent of our follow-up efforts, especially for the pretest survey; the initiation of the experimental program required that we eliminate many surveys that were returned after the experiment began.

Two additional weaknesses are components of the experimental program itself. During the experiment, the collection time restrictions were between 10 p.m. and 6 a.m. Pilot testing and stakeholder input suggested that a 7 a.m. cutoff time might have been more effective, but the desire to achieve cooperation from the garbage haulers made the 6 a.m. cutoff time more reasonable. Another inherent difficulty was that the experiment did not include one crucial element that is likely to be present outside of experimental conditions. That is, if collection times were in fact changed by ordinance or administrative rule, garbage haulers might adjust their collection fees upward to accommodate the timing restrictions. The experiment did not include any increase in collection fees or any spillover effects thereof (such as increased prices passed on to consumers).[32]

Strengths of this research

This research benefited from the study Portland State University conducted in 1994, also regarding noise and livability in Northwest Portland. For that study, we first conducted focus group interviews, which provided us with a rich source of information regarding residents' and business owners' perceptions about the quality of life in the Northwest. The focus group input enabled us to construct a survey instrument that captured many of the concerns of the residents and business owners in the Northwest in 1994. We based our 1999 survey on the 1994 survey, and our pilot-testing process revealed that very little modification of the instrument was necessary.

It is also important to acknowledge the valuable input of the steering committee, consisting of stakeholder interest group representatives, as well as representatives from other bureaus in the City. Their input helped ensure that the survey instrument included questions that addressed a range of stakeholder concerns.

Another strength of this study is its experimental design. Not often can public policy-makers can benefit from research that includes an experimental program, with before-and-after assessment. Although our small sample sizes preclude findings that are of statistical significance, they nevertheless suggest important trends and the viability of doing

[32] Stated-preference survey techniques, which use an experimental design to ask respondents to choose among a set of pricing options under different conditions, could have revealed some of these pricing impacts. Stated-preference techniques are, however, sophisticated and complex and would have been an unreasonable addition, given the limited scope of this study.

experimental policy research. We feel this is an important contribution to the study of urban policy-making. In addition, since the present research builds on a similar study we undertook in 1994, longitudinal comparisons will be possible for future analyses.

An additional strength of this research is that the design specifically addressed spillover effects by including questions about increased traffic (an expected negative impact of the experimental restrictions on garbage and recycling collection) and by sampling from residents and businesses within a nearby multiple-use district adjacent to the study area (the Pearl District), where we anticipated garbage collection might increase during the restricted hours.

Another element that enhances this research is our ability to geocode responses and correlate response patterns not only with the pre- and posttest conditions, but also with specific zones within or adjacent to the study area. Thus, we are able to distinguish the nature of responses that come from residents living within the core of the experimental area from those living outside of the experimental area.

Finally, the researchers attempted to address bias and ethical issues. A very real concern was that respondents would be able to "guess" the research goals of the survey. To avoid this, we included a wide variety of questions, giving the questionnaire the appearance of a survey about general livability. The City, steering committee, and researchers also attempted to keep the existence and nature of the experimental program unknown, so that residents and business owners would not be *expecting* a change in collection times. Finally, the researchers attempted to address the ethical concern raised by repeated mailings of surveys to residents and business owners in Northwest Portland, a frequently researched area. The cover letter to all versions of the survey (pretest, posttest, and follow-ups) stressed that response was completely voluntary, while at the same time attempting to convey the importance of hearing from as many respondents as possible.

Chapter

3

Findings with Respect to Livability

➪ Chapter summary

To understand Northwest residents' general feelings toward their neighborhood, the survey asked respondents to compare Northwest Portland with other Portland neighborhoods as a place to live, on a scale ranging from "much better" to "much worse." Over 85 percent of the residents in each phase of the study responded that Northwest Portland is a better place to live than other Portland neighborhoods.

Respondents placed the greatest value on proximity to activities: the ability to walk to activities and the close proximity to downtown rank as the neighborhood's top two quality-of-life features, both before and during the experimental program. These two aspects of Northwest Portland also ranked most and second-most important in the 1994 study. Responses regarding what makes Northwest Portland a good place to be were fairly consistent across the Commercial Core, In-Between, and Spillover zones.

In terms of negative attributes in general, parking, traffic, and property crime are top-ranking concerns of Northwest Portland residents, followed by the presence of homeless people, pedestrian-auto conflicts, and street drinking. Noise related to garbage collection ranked seventh or below, after these top-ranking problems.

Neighborhood satisfaction

Residents of Northwest Portland are generally satisfied with the quality of their neighborhood relative to other Portland neighborhoods.

To gain a sense of Northwest residents' general feelings toward their neighborhood, the survey asked respondents to compare Northwest Portland with other Portland neighborhoods as a place to live, on a scale ranging from "much better" to "much worse." As Figure 3.1 illustrates, over 85 percent of the residents in each phase of the study responded that Northwest Portland is a somewhat better or much better place to live than other Portland neighborhoods. Only 6 percent of those surveyed before the experimental program and 3 percent of those surveyed during responded that Northwest Portland is a worse place to live. These figures contrast favorably with a 1977 study that found that 69 percent of residents nationwide rated their neighborhoods as good or excellent places to live.[33]

[33] US Environmental Protection Agency, Office of Noise Abatement and Control, "Report Under Contract No. 68-01-4184" (Washington, DC, 1977).

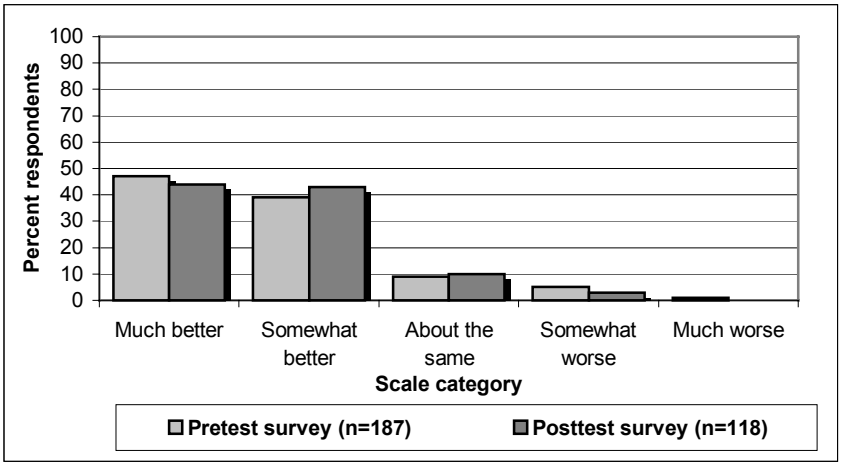


Figure 3.1. Resident responses to how NW Portland compares to other neighborhoods as a place to live. (Source: Northwest Livability Study, PSU 1999.)

Positive attributes of Northwest Portland

Respondents place the greatest value on proximity to activities: the ability to walk to activities and the close proximity to downtown rank as the neighborhood's top two quality-of-life features, both before and during the experimental program. These two aspects of Northwest Portland also ranked most and second-most important in the 1994 study. Responses regarding what makes Northwest Portland a good place to be were fairly consistent across the Commercial Core zone, the In-Between zone, and the Spillover zone.

What is it about Northwest Portland that residents value? The survey addressed this question by asking residents to score a series of neighborhood features in terms of whether they help make Northwest Portland "a good place to be." Possible responses ranged from "strongly agree" to "strongly disagree," on a 5-point scale. All "agree" responses (strongly agree and agree) were grouped together and ranked (see Table 3.1).

Over 90 percent of the respondents agree that the ability to walk to activities and be close to downtown enhance the livability of the neighborhood. At least 80 percent noted the range of activities as a positive attribute and at least 70 percent cited the ability to live *and* work in Northwest Portland. These positive attributes are all characteristics of a mixed-use neighborhood.

⇒ See Appendix B for a complete table of "agree," "neutral," and "disagree" resident responses by zone and survey phase.

Table 3.1. Percentage of resident responses agreeing that factor makes the Northwest neighborhood a good place to be right now. *Factors that fell in rank* o *are indicated in bold italics.* (Source: Northwest Livability Survey, PSU 1999).

Northwest Portland is a good place to be because of:	"Agree" responses *before* experiment[a]		"Agree" responses *during* experiment[b]	
	Percentage	Ranking[c]	Percentage	Ranking[c]
Ability to walk to activities	***98***	***1***	***95***	***2 o***
Close proximity to downtown	93	2	97	1 ρ
Quality of stores	***82***	***3***	***71***	***8 o***
Attractive architecture	***82***	***4***	***76***	***5 o***
Range of activities	80	5	81	3 ρ
Economic health	73	6	76	6
People can live AND work here	72	7	77	4 ρ
Mix of people living here	***68***	***8***	***70***	***10 o***
Night life activities	63	9	70	9
Safe night-time environment	***63***	***10***	***61***	***11 o***
Close proximity to Forest Park	62	11	72	7 ρ
People like me live here	58	12	54	12
Strong sense of community	54	13	51	13
Good real estate investment	39	14	44	14

[a] n = 192 [b] n = 123 [c] Ranking reflects percentage before rounding

Negative attributes of Northwest Portland

In terms of negative attributes in general, parking, traffic, and property crime are top-ranking concerns of Northwest Portland residents, followed by the presence of homeless people, pedestrian-auto conflicts, and street drinking. Noise related to garbage collection ranked seventh or below, after these top-ranking problems.

The survey also asked resident respondents to score, on a scale ranging from "strongly agree" to "strongly disagree," a series of neighborhood features that some people may view as problems in the area. All "agree" responses (strongly agree and agree) were grouped together and ranked (see Table 3.2).

In both pre- and posttest surveys, lack of parking and the theft of and breaking into automobiles were the top two livability concerns, with approximately 75 percent of all respondents agreeing in each survey that they are a problem. The third- and fourth-ranked concerns (before and during the experiment) were vandalism and traffic congestion, respectively.

When analyzed by zone, traffic congestion is of greater concern to resident respondents living in the Commercial Core and the Spillover Zone than in the In-Between Zone. This was expected, as these areas—along Northwest 23rd and 21st avenues and in the Pearl District—have a higher activity level than that found in the In-Between Zone. However, residents in all three zones expressed similar degrees of concern about the lack of parking.

Table 3.2. Percentage of resident respondents agreeing that factor is a neighborhood problem. *Factors that fell in rank* o *are indicated in bold italics.* (Source: Northwest Livability Survey, PSU 1999.)

Are these problems in Northwest Portland?	"Agree" responses *before* experiment[a]		"Agree" responses *during* experiment[b]	
	Percentage	Ranking[c]	Percentage	Ranking
Too little parking	***78***	***1***	***74***	***2 o***
Auto theft and break-ins	76	2	77	1 ρ
Vandalism	66	3	65	3
Too much traffic	61	4	59	4
Presence of homeless people	***51***	***5***	***41***	***8 o***
Pedestrian/auto conflicts	50	6	56	5 ρ
Street drinking	47	7	46	6 ρ
Traffic noise	43	8	44	7 ρ
Garbage collection noise	43	9	40	9
Too many outsiders using area	***30***	***10***	***21***	***13 o***
Night life noise	***27***	***11***	***22***	***12 o***
Recycling collection (glass, etc.)	***23***	***12***	***23***	***10 o***
Hard to find basic goods	***17***	***13***	***23***	***11 o***
Too many bars	15	14	15	14

[a] n = 192 [b] n = 123 [c] Ranking reflects percentage before rounding

⇒ See Appendix C for a complete table of "agree," "neutral," and "disagree" responses by zone and survey phase.

Fewer than one quarter of the residents surveyed—both before and during the experimental program—agree that "too many bars," "hard to find basic goods," and "recycling collection noise" are problems in Northwest Portland. It is important to note, however, that finding basic goods is a problem for approximately one third of respondents living in the Spillover areas (27 percent before the experimental program and 44 percent during). This is likely due to the lack of a grocery or drug store in the Pearl District.

Chapter
4

Findings with Respect to Noise

➪ Chapter summary

Eighty-four percent of the respondents said they had been bothered by noise outside their home in the two weeks before the experimental program began, while only 75 percent said they had been bothered during the experimental period. The largest percentage of people identified anti-theft alarms on cars or buildings as the major source of this bothersome noise, followed by "people outside talking loudly or shouting" and "garbage collection and dumping."

During the experimental period, the perception of garbage-related noise as a problem dropped by a greater percentage (17 percent), on average, than did the perception of the other sources of noise (an average drop of only 10 percent).

On weekdays, before the experimental program, the largest percentage of respondents (62 percent) reported bothersome noise occurring in the morning hours, between 6 a.m. and 10 a.m. This decreased, as expected, to 55 percent, but there was also an unexpected 15-percent *increase* in the percentage of people reporting weekday noise as bothersome between the hours of 2 a.m. and 6 a.m.; this may be due to the fact that the garbage collection started up again right at 6 a.m., awakening people before they wanted to awaken. Results were similar for the weekend.

Nearly all residents surveyed both before and during the experimental program reported that their sleep had been disturbed at least once. About 40 percent indicated that their sleep had been disturbed by outside noise two to three times over the past two weeks. Noise from garbage collection and dumping and from recycling collection—two of the top three sources of sleep-disturbing noise identified before the experimental program—both became less important sources of sleep-disturbing noise during the experimental program.

The survey also asked people to rate the noise level where they live, the noise level they believe the "average person" would want to live, and the "ideal" noise level where they would like to live. For 82 percent of the respondents, the noise level of the ideal place to live is between 0 and 5, whereas for approximately the same percent, the noise level where they presently live is between 4 and 10. In fact, 25 percent said the area where they presently live is in the 8 to 10 range ("a noisy, bustling, active place" to "too noisy, too much activity"). Finally, the survey asked residents, in an open-ended question, to provide suggestions for improving the noise situation. The most common response was to restrict all loud noises before 7 or 8 a.m. Many residents specifically suggested restricting garbage collection before these times.

Noise as an overall problem

When asked about "noise overall," about 40 percent of the respondents indicated that noise was a problem before the experiment; during the experiment, this dropped to about 34 percent. In addition, 84 percent of the respondents said they had been bothered by noise outside their home in the two weeks before the experimental program began, while only 75 percent said they had been bothered during the experimental period.

Moving to the particular issue of noise, the survey went on to ask general and increasingly specific questions about noise. Two very general questions indicate that residents' perception of noise as a bothersome phenomenon did decrease during the experimental program. As Figure 4.1 illustrates, before the experimental program, about 40 percent of the respondents indicated that noise was a problem. During the experiment, this dropped to about 34 percent. Our pretest figure is similar to (although slightly lower than) a 1977 study that found that, nationwide, 46 percent of the respondents said they were "bothered or annoyed" by noise in their neighborhood.[34]

It is important to note that on our survey, this question measures "overall noise" in the neighborhood and does not isolate specific noise sources, such as garbage and recycling collection. Any number of noise sources could be responsible for shifts in individuals' perceptions of noise over this period. Additional survey questions, discussed later, provide detail about sources of noise and levels of annoyance.

Figure 4.2 illustrates another question related to noise in general. When we asked respondents specifically whether or not they had been *bothered* by noise *outside their home* over the past two weeks, 84 percent they had been bothered in the period before the experimental program began, while only 75 percent said they had been bothered in the period during which they experimental program took place. Again, this question did not ask about specific sources of noise. We move on to discuss that in the next section.

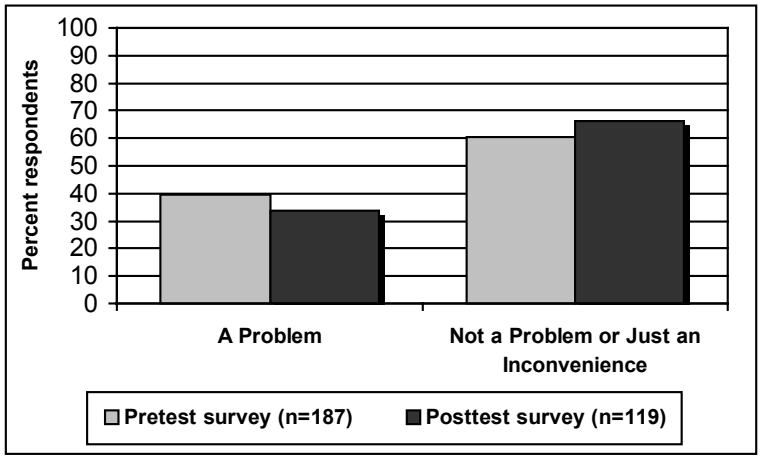


Figure 4.1. Distribution of residents believing that overall noise is not a problem or just an inconvenience versus those who feel that overall it is a problem. (Source: Northwest Livability Survey, PSU 1999).

[34] Ibid., pp. 7-9.

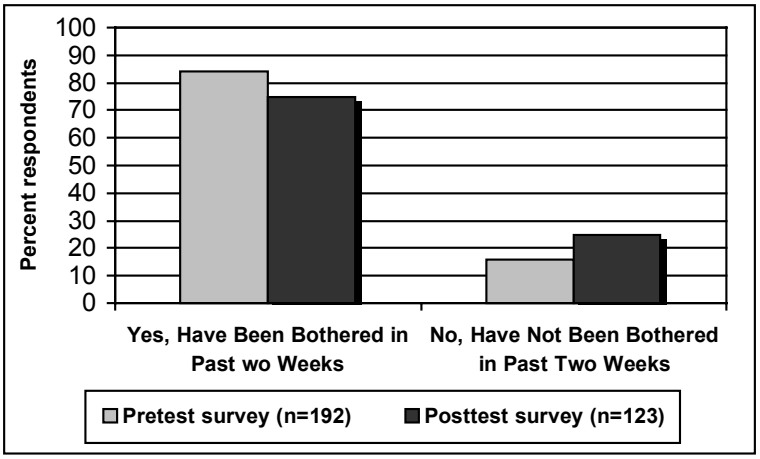


Figure 4.2. Distribution of residents indicating whether they have been *bothered by noise outside their home* in the past two weeks. (Source: Northwest Livability Survey, PSU 1999).

Sources of bothersome noise

As for different sources of bothersome noise, the largest percentage of people identified anti-theft alarms on cars or buildings as a problem. This is followed by "people outside talking loudly or shouting" and "garbage collection and dumping." In the pretest period, 48 percent of the respondents rated both of these sources as problematic. In both cases, the percentage fell in the posttest period—to 42 percent rating people talking loudly and 43 percent rating garbage collection as problematic noise sources.

Figure 4.3 isolates the sources of bothersome noise. In both the pre- and posttest periods, the largest percentage of people identified anti-theft alarms on cars or buildings as a source of noise that they considered a problem. This is followed by "people outside talking loudly or shouting" and "garbage collection and dumping," both of which were rated similarly as problematic noise sources both before and during the experiment. In the pretest period, 48 percent of the respondents rated both of these sources as problematic. In both cases, the percentage fell in the posttest period—to 42 percent rating people talking loudly and 43 percent rating garbage collection as problematic noise sources.

It is apparent in Figure 4.3 that a variety of noise sources were becoming more or less noticeable over this period. For instance, summer-related noises such as traffic noise, construction noise, and people talking loudly or shouting outside all decreased in importance. Other factors—noise from delivery trucks, industrial noise, and freeway noise—became more noticeable sources of noise. Whether noise from these latter sources actually increased or simply became more noticeable as garbage- and summer-related noises lessened is impossible to determine.

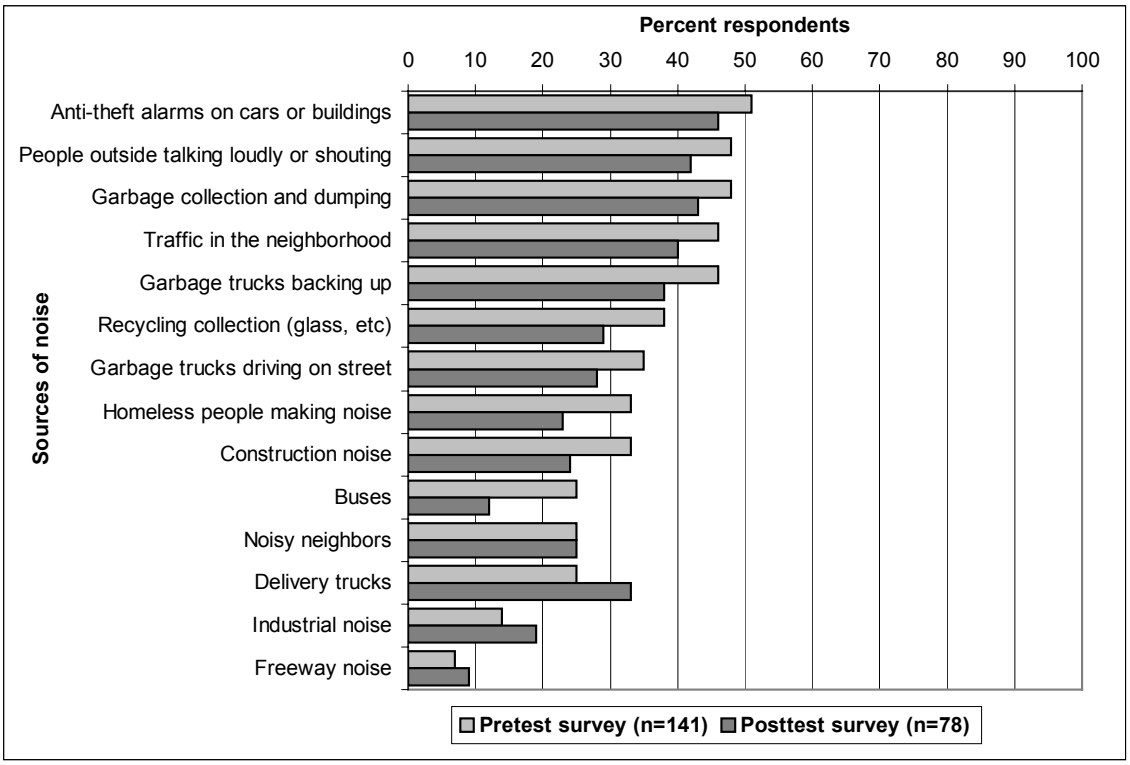


Figure 4.3. Percentage of residents who responded that noise source was a problem for them in the past two weeks. (Source: Northwest Livability Survey, PSU 1999).

Garbage-related noise

During the experimental period, the perception of garbage-related noise as a problem dropped by a greater percentage, on average, than did the perception of the other sources of noise. An average of 41 percent of the respondents indicated that garbage-related noise sources were a problem before the experiment. This dropped by over 17 percent to only 34 percent of the respondents in the posttest period. By contrast, an average of about 31 percent of the respondents rated all other sources of noise as a problem before the experimental program. This dropped by only 10 percent during the experimental period.

Figure 4.4 isolates the garbage-related noise from all other sources of noise. As the figure illustrates, before the experimental program, an average of 41 percent of the respondents

indicated that garbage collection and dumping, garbage trucks backing up, recycling collection, and garbage trucks driving on the street all constituted problematic sources of noise. This dropped by over 17 percent to only 34 percent of the respondents in the posttest period. By contrast, an average of about 31 percent of the respondents rated all other sources of noise as a problem before the experimental program. This dropped by about 10 percent during the experimental period. Thus, while the percentage of respondents identifying various noise sources as problematic decreased in some cases and increased in others, when we aggregate all sources related to garbage, it is clear that the perception of garbage-related noise as a problem dropped by a greater percentage, on average, than did the perception of the other sources of noise.

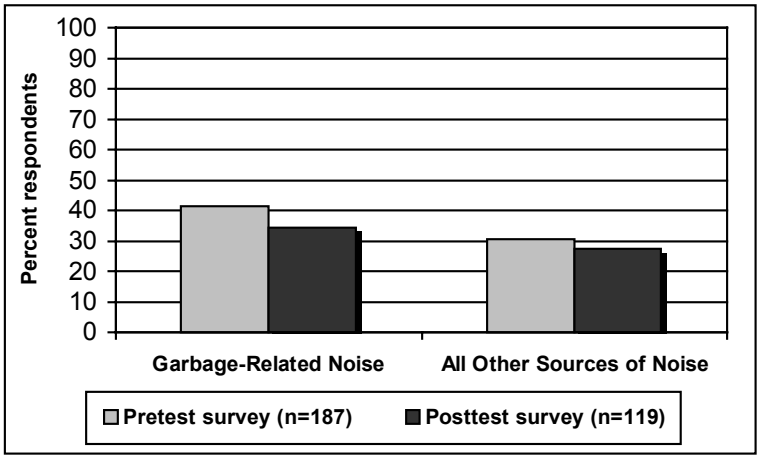


Figure 4.4. Average percentage of respondents indicating that all garbage-related noise sources were a problem compared with the average number indicating that all other sources of noise were a problem. (Source: Northwest Livability Study, PSU 1999).

Garbage-related noise by zone

The percentage of respondents who indicated that garbage-related noises were a problem decreased for all types of garbage-related noise sources in the Commercial Core. The greatest percent change was with respect to the noise produced by garbage trucks backing up. Even greater decreases occurred in the In-Between Zone, which we did not initially expect. Here, the greatest percent decrease was in the percentage of respondents citing the noise generated by garbage trucks driving on the streets as a problem. For the most part, the expected negative effects of increased garbage-related noise did not occur in the Spillover Zone, where we thought they would occur. The exception to this was the perception of bothersome noise associated with garbage trucks driving on the street, which jumped by over 100 percent in the Spillover Zone. The most likely explanation for this is that trucks move through the Spillover Zone into the experimental area just a few minutes before 6 a.m., thus awakening those who'd otherwise have slept until at least 6 a.m.

To help isolate the effects of the experimental program, we have looked at the changes in garbage-related noises by zone. As Map 2.1 in Chapter 2 illustrates, we divided the study area into three zones.

Zone 1, the **Commercial Core**, is the area within 200 feet of the commercial corridors of Northwest 21st and 23rd avenues. This zone also includes the area *between* Northwest

21st and 23rd, as we determined that the character of this area to be similar to the character of the areas within 200 feet of these streets. We anticipated that commercial waste collection would strongly affect these areas, and we therefore expected these areas to experience the greatest direct impact from the experimental program.

Zone 2, the **In-Between Zone**, is the area immediately surrounding the Commercial Core. We anticipated that commercial waste collection would also affect residences and businesses within this zone, but to a lesser degree than in the Commercial Core. We therefore expected the effects of the experimental program to be in the same direction as in the Commercial Core, but less dramatic.

Zone 3, the **Spillover Zone**, is the area outside of the Commercial Core and the In-Between Zone, beyond 200 feet of the experimental area's outermost boundaries. We anticipated that these areas would receive some spillover impacts from the experimental program. This area includes the Pearl District, which as a mixed-use area, may experience problems similar to those of the Northwest Neighborhood commercial areas.

In the Commercial Core

In terms of distribution, nearly half of all resident respondents (48 percent) live within the Commercial Core Zone. Figure 4.5 reveals that the percentage of respondents who indicated that garbage-related noises were a problem, a big problem, or a very big problem did decrease for all types of garbage-related noise sources in the Commercial Core. Although the percent-changes were not as great as we might have expected, they were all in the anticipated direction. The greatest percent change was with respect to the noise produced by garbage trucks backing up. Before the experimental program, 53 percent of residents in the Commercial Zone indicated that noise from this source was a problem. This decreased by 17 percent to 41 percent during the experiment. The next largest decrease was in garbage trucks driving on streets, which decreased by 7 percent, from 41 percent of the respondents indicating that this source of noise was a problem before the experiment to 33 percent during.

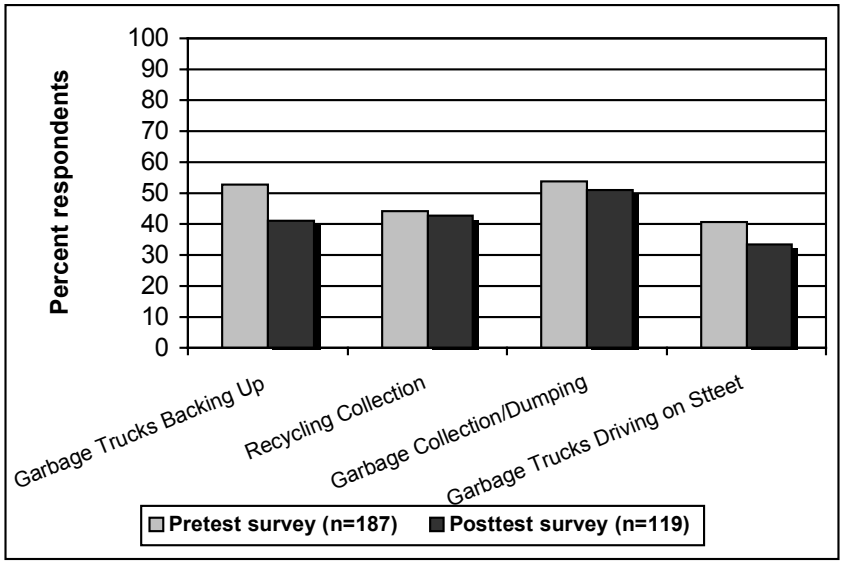


Figure 4.5. Percent of Commercial Core respondents indicating that garbage-related noise sources are a problem, before and during the experiment. (Source: Northwest Livability Study, PSU 1999).

In the In-Between Zone

Figure 4.6 shows the shifts in the In-Between Zone. Although this is the area immediately surrounding the Commercial Core, we didn't expect results to be as dramatic here because we assumed that the most intense areas of mixed land uses and associated bothersome noise would be in the Commercial Core rather than adjacent to it. This may be true, but perhaps the residents in the Commercial Core are more accustomed to urban noise, which may explain why the change in their perceptions was not as dramatic as for those in the In-Between areas. At any rate, the changes in the In-Between Zone were also in the anticipated direction, and, as noted, at even greater rates than expected.

Contrary to the Commercial Core, the decrease in the percentage of In-Between area residents who considered the noise of garbage trucks backing up was negligible—a less than 1-percent change from before the experiment to the period during. The percent-change in those indicating that recycling collection was a problem was more marked—a 12-percent decrease, from 31 percent before the experimental program to 19 percent during. The noise from garbage collection and/or dumping was rated as a problem by 43 percent of the respondents before the experiment, declining by 6 percent to 37 percent during. The most dramatic change was in the percentage of respondents citing the noise generated by garbage trucks driving on the streets as a problem. This fell 29 percent from 37 percent of the respondents citing it as a problem before the experiment to only 8 percent during.

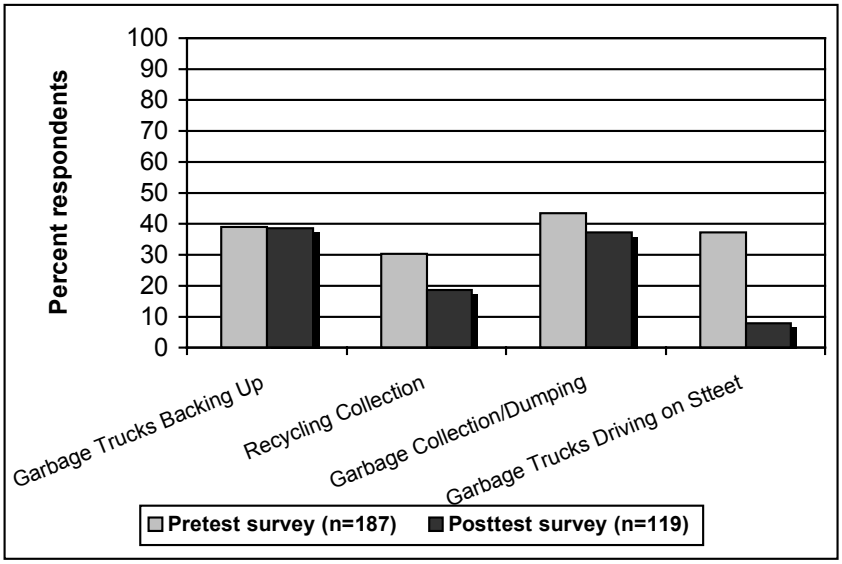


Figure 4.6. Percent of In-Between Zone respondents indicating that garbage-related noise sources are a problem, before and during the experiment. (Source: Northwest Livability Study, PSU 1999).

In the Spillover Zone

As a result of the time restrictions in the Northwest neighborhood, we anticipated that early-morning garbage collection would *increase* in the Spillover Zone, thereby increasing the likelihood of bothersome noise in these areas. We expected the increase because we assumed that garbage haulers would move their nighttime operations to the nearest commercial or mixed-use neighborhood immediately outside of the experimental program, which is the area we dubbed the "Spillover Zone." Figure 4.6 suggests that for the most part, the expected spillover effects of increased garbage-related noise did not occur where we thought they would occur. There may in fact have been spillover noise generated by the haulers moving their nighttime operations elsewhere, but if so, this noise occurred outside the area we expected.

As Figure 4.7 shows, the percentage of Spillover Zone respondents citing noise as a problem decreased for all garbage-related activities *except* garbage trucks driving on the street. The percentage of respondents considering this a problem jumped by over 100 percent, from 18 percent before the experimental program to 39 percent during. The most likely explanation for this is that as trucks move into the experimental area right at the first moment permitted during the experiment—6 a.m.—they move in greater numbers, many at the same time. They are likely to have been passing through the Spillover Zone in the minutes right before 6 a.m. As noted elsewhere in this report, the noise of a truck moving along a street is typically over 75 dB, enough to waken almost anyone. Those in the Spillover Zone wanting to sleep until *at least* 6 a.m. may have been awakened earlier as the trucks moved through their streets, ready to enter to experimental area just as the clock struck 6 a.m.

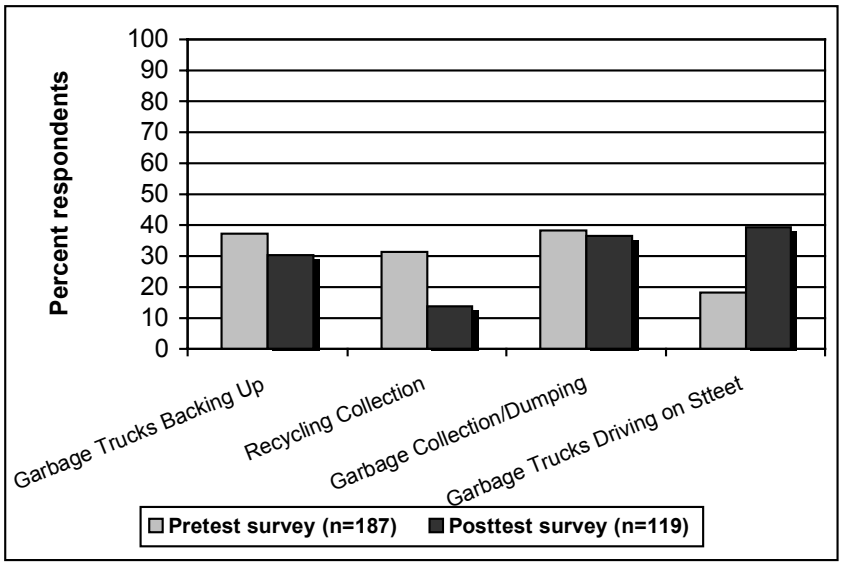


Figure 4.7. Percent of Spillover Zone respondents indicating that garbage-related noise sources are a problem, before and during the experiment. (Source: Northwest Livability Study, PSU 1999).

Garbage-related noise by time

On weekdays, before the experimental program, the largest percentage of respondents (62 percent) reported bothersome noise occurring in the morning hours, between 6 a.m. and 10 a.m. This decreased, as expected, to 55 percent. The percentage of those reporting bothersome noise during the rest of the day increased for the most part, also as expected. There was also an unexpected 15-percent *increase* in the percentage of people reporting weekday noise as bothersome between the hours of 2 a.m. and 6 a.m.; this may be due to the fact that the garbage collection started up again right at 6 a.m., awakening people before they wanted to awaken.

Results were similar for the weekend. The most noticeable difference between weekends and weekdays is that on the weekends, noise is reportedly more bothersome between 10 p.m. and 2 a.m. and less bothersome during the morning hours of 2 a.m. to 10 a.m. This is likely due to the higher nighttime activity levels along NW 21st and 23rd avenues on the weekends, combined with less early-morning activity, including garbage collection.

Weekdays

The survey also asked respondents to identify the time(s) when noise had been most bothersome for them over the past two weeks. Although we are unable to make a direct link between the noise source and the time of noise (because of multiple response choices in both question sets), this section helps us to understand when noise is most likely to be a problem for people. We can also look at whether the perception of bothersome noises declined during the experimental program, in the hours when garbage collection was being restricted.

As Figure 4.8 reveals, before the experimental program, the largest percentage of respondents (62 percent) reported bothersome noise occurring in the morning hours, between 6 a.m. and 10 a.m. This decreased, as expected, to 55 percent. We expected the percentage of people reporting bothersome noise during the rest of the day, up until 10

p.m., to increase, on the assumption that garbage activity would increase between 6 a.m. and 10 p.m. The findings are, for the most part, consistent with our expectations, showing increases in the percentage of those reporting bothersome noise between 2 p.m. and 10 p.m., and then decreasing between 10 p.m. and 2 a.m. There is, however, an *increase* in the percentage of people reporting noise as bothersome between the hours of 2 a.m. and 6 a.m.: a 15-percent increase from 27 percent of respondents to 31 percent. We believe this increase may be due to the fact that the garbage collection started up again right at 6 a.m., awakening people before they wanted to awaken. The unpleasant experience of being woken early may cause respondents to characterize the bothersome noise as occurring in the "early morning" hours of 2 a.m. to 6 a.m. rather than the "morning" hours of 6 a.m. to 10 a.m. Ideally, the survey would not have listed overlapping time categories, but we felt that identifying "early morning" as 2 a.m. to 5:59 a.m. and "morning" as 6 a.m. to 9:59 a.m. would be been undesirably cumbersome.

In addition, the fact that the largest percentage of respondents cite the morning hours of 6 a.m. to 10 a.m. as being the most bothersome may indicate that ending the garbage restriction at 6 a.m. was too early. Extending the restriction to 7 a.m. or even 8 a.m. may have resulted in a more profound effect.

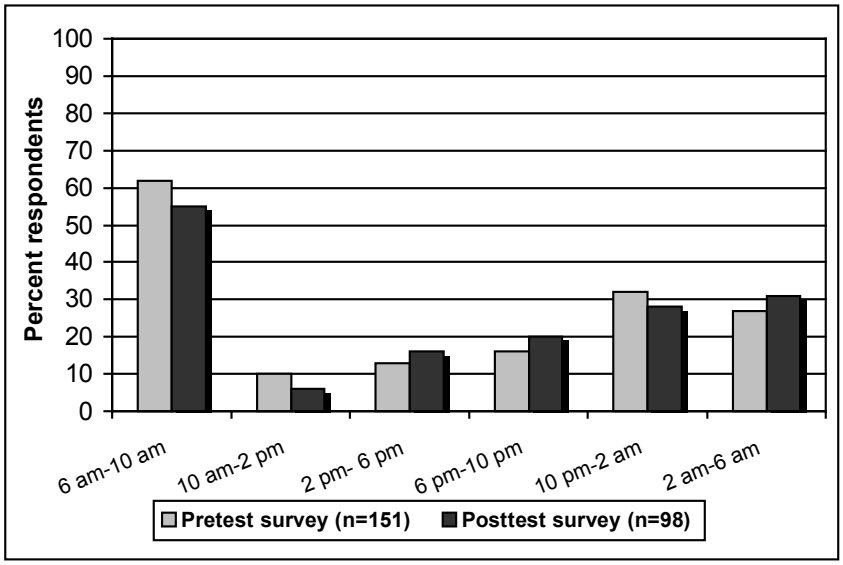


Figure 4.8. Percent of residents reporting that noise has been the most bothersome over the past two weeks during various four-hour blocks, weekdays only. (Source: Northwest Livability Study, PSU 1999).

Weekends

During the experimental program, we anticipated that reports of bothersome noise would shift in the same direction as anticipated for weekdays, but to a lesser degree since garbage collection activity is lower on the weekends. As Figure 4.9 shows, this is for the most part what we found.

The most noticeable difference between weekends and weekdays is that on the weekends, noise is reportedly more bothersome between 10 p.m. and 2 a.m. and less

bothersome during the morning hours of 6 a.m. to 10 a.m. This is likely due to the higher nighttime activity levels along NW 21st and 23rd avenues on the weekends. The only other difference between weekdays and weekends is that the percentage of those reporting bothersome noise in the early morning hours of 2 a.m. to 6 a.m. decreased during the experiment, from 27 to 24. Thus, whatever noise was occurring in Northwest Portland, the percentage of people who considered it bothersome decreased during the experimental period. Of course, as with weekdays, it is impossible to identify the reason for this decrease, although it is what we expected to occur as a result of the experiment.

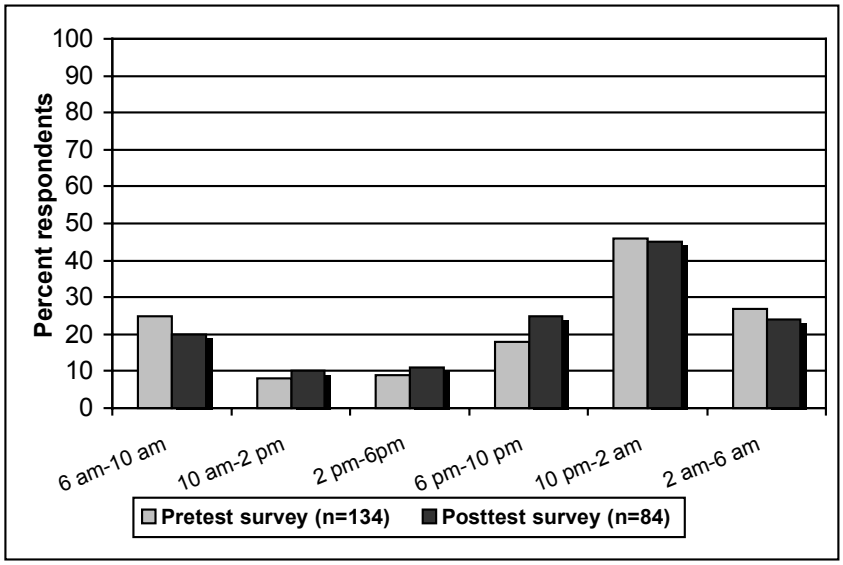


Figure 4.9. Percent of residents reporting that noise has been the most bothersome over the past two weeks during various four-hour blocks, weekends only. (Source: Northwest Livability Study, PSU 1999).

Sleep-disturbing noise

Frequency of "sleep-disturbing" noise

Nearly all residents surveyed both before and during the experimental program reported that their sleep had been disturbed at least once. About 40 percent indicated that their sleep had been disturbed by outside noise two to three times over the past two weeks. This contrasts with a 1977 study that revealed that, nationwide, only 21 percent of respondents reported having been annoyed from sleep disturbance caused by neighborhood noise. That study found a correlation between higher levels of sleep disturbance by noise and population density; our findings confirm this correlation, with Northwest Portland having among the highest densities in the state.

The most dramatic shifts detected during the experimental program occurred in the In-Between Zone, where reports of disturbed sleep were less frequent during the experimental program, and in the Spillover Zone, where reports of disturbed sleep were more frequent. These shifts were both in the anticipated direction. Reports of sleep-disturbing noise by Commercial Core residents remained relatively constant. One explanation for this is, again, that the 6 a.m. cutoff may not have been late enough for these residents.

Figure 4.10 reveals that, when asked if they have "had difficulty getting to sleep or been woken from sleep during the last two weeks because of noise outside [their] home," nearly all residents surveyed both before and during the experimental program reported that their sleep had been disturbed at least once. The largest percentage (about 40 percent) indicated that their sleep had been disturbed by outside noise two to three times over the past two weeks. Only 10 percent of the respondents said they had *never* had their sleep disturbed by outside noise. These figures contrast with the 1977 study that revealed that, nationwide, 21 percent of respondents reported having been annoyed from sleep disturbance caused by neighborhood noise.[35] Although our survey asked the question about sleep disturbance differently, it appears that respondents to our survey experience *more* sleep disturbance from outside noise than on average nationwide. The 1977 nationwide survey found a correlation between higher levels of sleep disturbance by noise and population density.[36] This may explain the more profound effects in our study area, which has among the highest population densities in the state.

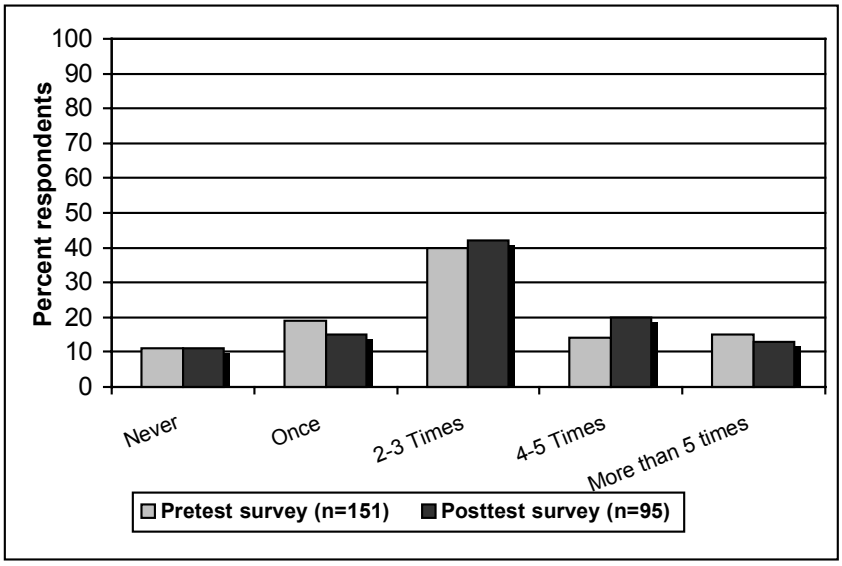


Figure 4.10. Percent of residents reporting the number of times they had had their sleep disturbed by noise outside their home over the past two weeks. (Source: Northwest Livability Study, PSU 1999).

At first glance, the experimental program appears to have had no effect on sleep-disturbing noise. To explore this finding further, we again broke the results down by zone.

As Table 4.1 shows, in the In-Between areas, the share of residents who reported *not* having their sleep disturbed even once over the past two weeks by noise outside their home increased 8 percent, from 16 percent of the total respondents to 24 percent. In other words, fewer people were—reportedly—waking up or having trouble getting to sleep due to noise outside their home during the experimental program than before. Also, the

[35] Ibid., p. 30.
[36] Ibid., p. 78.

share of residents reporting that sleep-disturbing noise occurred more than 5 times in the past two weeks declined by nearly 5 percent. We expected this result.

In the Spillover areas, the share of residents who reported not having their sleep disturbed in the past two weeks moved in the opposite direction, dropping approximately 10 percent, from 18 percent of total respondents to 8 percent. We expected this result, because we predicted that noise produced by garbage collection would be occurring in the Spillover Zone either because that would be where haulers would divert their nighttime and early-morning collection or because that's the zone through which haulers would travel to reach the boundaries of the experimental area at the stroke of 6 a.m.

Interestingly, reports of sleep-disturbing noise by Commercial Core residents remained relatively constant, indicating one of two things. First, it could mean that the absence of garbage collection noise between the hours of 10 p.m. and 6 a.m. did not improve sleeping conditions in the Commercial Core. This may be because the 6 a.m. cutoff was not late enough for Commercial Core residents or because garbage-related factors were not the source of sleep-disturbing noise in the first place. Second, this finding could mean that an increase in nighttime noise from other sources counteracted the reduction in garbage-related noises, making it difficult to evaluate the influence of the experimental program.

Table 4.1. Percentage of residents reporting have had their sleep disturbed by noise outside their home over the past two weeks. (Source: Northwest Livability Survey, PSU 1999).

	Never		Once		2-3 times		4-5 times		More than 5 times	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
	Percent Respondents		Percent Respondents		Percent Respondents		Percent Respondents		Percent Respondents	
Commercial Core[a]	6	4	20	20	39	35	19	26	16	15
In-Between Zone[b]	16	24	26	8	40	44	5	16	13	8
Spillover Zone[c]	18	8	9	13	46	54	12	13	15	13

[a] n = 80 (pretest), 46 (posttest); [b] n = 38 (pretest), 25 (posttest); [c] n = 33 (pretest), 24 (posttest)

Sources of "sleep-disturbing" noise

Noise from garbage collection and dumping and from recycling collection—two of the top three sources of sleep-disturbing noise identified before the experimental program—both became less important sources of sleep-disturbing noise during the experimental program. These findings suggest that although trucks driving on streets was cited as a major source of *bothersome* noise, it is not as important a source of *sleep-disturbing* noise as are garbage and recycling dumping and collection. This is in line with what we know about the higher decibel and frequency levels and impulse-intermittent nature of dumping and collection, compared with that of trucks driving.

To understand more completely the influence of the experimental program, we also attempted to identify the sources of "sleep-disturbing" noise. The survey asked residents to rank their top three sources of sleep-disturbing noise, from a list of potential noise sources. As Table 4.2 shows, among the responses we collected before the experimental program, garbage collection and dumping noise tied with loud people as the No. 1 source of sleep-disturbing noise, with recycling collection noise representing the next greatest source.

During the experimental program, garbage collection and dumping moved from tying with loud people outside as the most frequently reported source of noise to ranking second. Recycling noise dropped from third to fifth. The other two garbage-related noise sources—garbage trucks backing up and garbage trucks driving on the street—do not appear to be an important source of sleep-disturbing noise, either before or during the experimental program. These findings suggest that although trucks driving on streets was cited as a major source of *bothersome* noise, it is not as important a source of *sleep-disturbing* noise as are garbage and recycling dumping and collection. This is in line with what we know about the higher decibel and frequency levels and impulse-intermittent nature of dumping and collection, compared with that of trucks driving.

Table 4.2. Ranking of factors identified by residents as a top three source of sleep-disturbing noise over the past two weeks. *Factors that fell in rank* o *are indicated in bold italics.* (Source: Northwest Livability Survey, PSU 1999).

Source of sleep-disturbing noise	Ranking PRETEST	Ranking POSTTEST
Loud people outside	1	1 *n.c.*
Garbage collection/dumping	***1***	***2*** **o**
Recycling collection (glass, etc.)	***3***	***5*** **o**
Anti-theft alarms	4	3 ρ
Traffic in neighborhood	5	4 ρ
Construction noise	***6***	***11*** **o**
Homeless people making noise	***7***	***8*** **o**
Garbage trucks backing up	8	7 ρ
Noisy neighbors	9	5 ρ
Buses	***10***	***12*** **o**
Delivery trucks	11	8 ρ
Garbage trucks driving on street	12	10 ρ
Other	***12***	***13*** **o**
Industrial noise	14	13 ρ
Freeway noise	15	13 ρ

⇒ See Appendix E for a complete table of ranked factors by zone.

Neighborhood noise scale

The survey asked people to rate the noise level where they live, the noise level they believe the "average person" would want to live, and the "ideal" noise level where they would like to live. The scale ranged from 0 (a calm, very quiet place) to 10 (too noisy, too much activity). For 82 percent of the respondents, the noise level of the ideal place to live is between 0 and 5, whereas for approximately the same percent, the noise level where they presently live is between 4 and 10. In fact, 25 percent said the area where they presently live is in the 8 to 10 range ("a noisy, bustling, active place" to "too noisy, too much activity").

To gain an understanding of how residents perceive the noise levels around their home, the survey asked residents to rate certain situations using the following Neighborhood Noise Scale:

Table 4.3. Neighborhood noise scale. (Source: Northwest Livability Survey, PSU 1999).

0	2	4	6	8	10
A calm, very quiet place	Activity and noise of a quiet residential area	Usually quiet, with some busy times	Lively	A noisy, bustling, active place	Too noisy, too much activity

Perceived and ideal noise levels

Figure 4.11 compares the noise level that respondents said characterizes where they currently live with the ideal noise level they said they'd like to have where they live and that they believe is where the "average person" would like to live.

In all cases, the largest percentage of respondents indicated the 4-5 range ("usually quiet, with some busy times" to just short of "lively") as characterizing where they currently live, where they'd like to live, and where they think the average person would like to live.

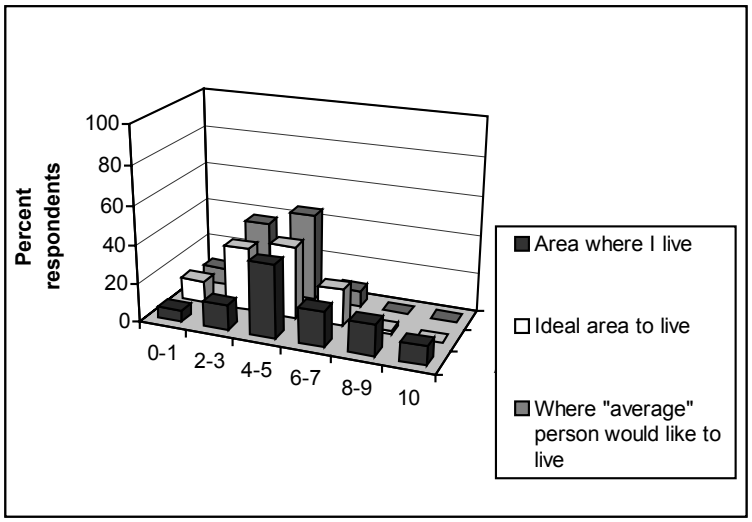


Figure 4.11. Noise level of the area where residents said they actually lived (n=303), the ideal noise level that they would like (n=310), and where the "average" person would like to live (n=302). (Source: Northwest Livability Survey, PSU 1999).

However, for the vast *majority* of respondents (82 percent), the ideal area to live is between 0 and 5, that is, ranging from "a calm, very quiet place" to just short of "lively." This contrasts sharply with where the vast majority (81 percent) said they do in fact live, which is in the 4-10 range ("usually quiet, with some busy times" to "too noisy, too much activity"). In fact, over 25 percent characterize the area where they presently live as ranging from "a noisy, bustling, active place" to "too noisy, too much activity." Yet, no respondents felt that the average person would want to live in this range, and only 2 percent indicated that the "noisy, bustling active place" was their ideal.

Suggestions for improving the noise situation

The survey asked residents, in an open-ended question, to provide suggestions for improving the noise situation. The most common response was to restrict all loud noises before 7 or 8 a.m. Many residents specifically suggested restricting garbage collection before these times.

Finally, with respect to noise, the survey asked residents, in an open-ended question, to provide suggestions for improving the noise situation in Northwest Portland. Figure 4.12 presents the results. Of those that were frequent enough to code, the most common response—constituting one third of the total responses—was to restrict all loud noises before 7 or 8 a.m. Further, within this category, many residents specifically suggested restricting garbage collection before these times.

This finding suggests two things: first, that residents believe that a time restriction on garbage collection may help to reduce noise levels in the area. Second, it provides further evidence that the 6 a.m. cutoff time for the experimental program may have been too early for many people even to notice a difference in garbage collection times. In other words, even though garbage collection did not start until 6 a.m., people were still waking up during the experimental program—as a result of outside noises—before they wanted to.

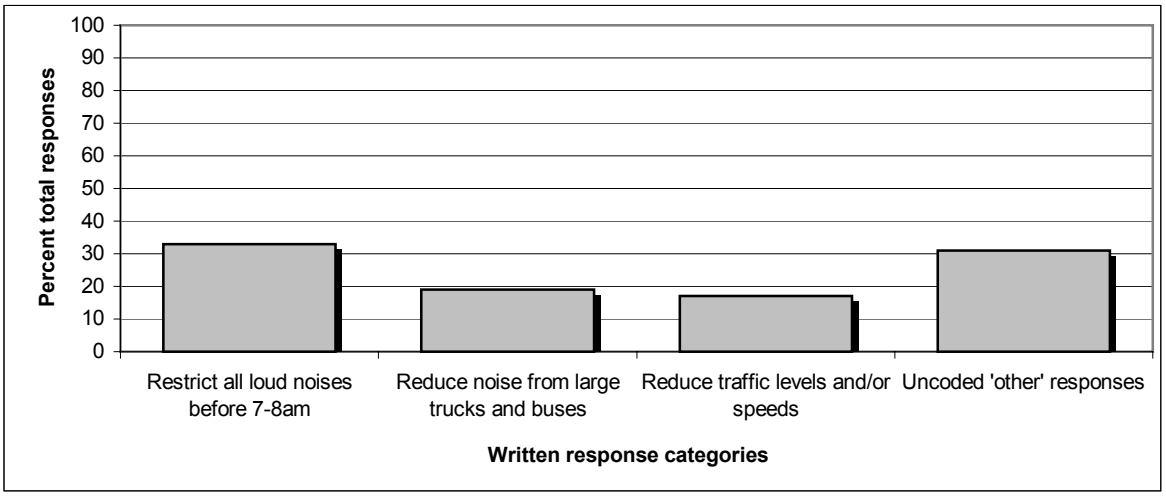


Figure 4.12. Suggestions provided by all residents for improving the noise situation in Northwest Portland (percentage of total responses, n=182). (Source: Northwest Livability Survey, PSU 1999).

Chapter

5

Findings with Respect to Spillover Implications

➪ Chapter summary

We looked at four types of unintended negative consequences that might have resulted from the experimental program. These were increased garbage collection noise in the Spillover Zone; increased traffic throughout the area during peak commute times; increased disruption to businesses, both in terms of noise and traffic; and the potential of increased prices passed on to consumers because haulers might face increased costs.

Perceptions of garbage-related noise did *not* occur where we thought they would. In fact, the percentage of Spillover Zone respondents citing noise as a problem decreased for all garbage-related activities *except* garbage trucks driving on the street. The most likely explanation for this is that trucks are likely to have been passing through the Spillover Zone in the minutes right before 6 a.m.

There was *no difference* in perceptions of traffic congestion among residents surveyed before and during the experimental program. Both before and during the experiment, the two most frequently cited sources of traffic congestion were the construction of the Central City Streetcar and the closure of the Lovejoy Ramp.

Among business owners, noise in general is not a high-priority concern. During the experimental program, there was an increase in concern over garbage collection noise from businesses outside of the Commercial Core, but the increase was very small.

The effect that a permanent time restriction on commercial garbage collection might have on both residential and commercial collection costs and, hence, increased prices for the consumer was not assessed, but remains an important policy consideration.

We were concerned with four types of "spillover effects," or unintended negative consequences of the experimental program.

- **Spillover garbage- and recycling collection noise in areas outside of but adjacent to the experimental area**. We were concerned about this because we thought that the haulers might move their operations to the nearest area where time constraints were not in place. For this reason, we included the Pearl District in our sample and separated out results by zone, one of which was the "Spillover Zone." The Spillover Zone included border streets right outside the experimental area, as well, because trucks could operate on the farthest side of the border streets and on outward (unless the area beyond was classified as residential).

- **Increased traffic congestion during peak commute times**. We thought that if haulers began working at 6 a.m., they would be competing with heavy on-street commute traffic in the already-congested area of Northwest Portland. We were concerned both with the flow of traffic being interrupted by increased hauler activity, as

well as safety compromises to the haulers themselves, who must exit and enter their vehicles and carry out much their work in lanes of active traffic flow.

- **Increased disruption to businesses, especially for restaurants during meal-serving times**. We were also concerned that increased garbage-collection activity might impede access to businesses and on-street parking.

- **Pricing effects**. Finally, we were concerned that a permanent policy that would limit the hours of commercial garbage and recycling collection would result eventually in haulers needing to increase their prices to maintain efficient operations. Although we were unable to assess this, we do discuss it briefly below.

Spillover collection noise in adjacent areas

The expected spillover effects of increased garbage-related noise did not occur where we thought they would occur. In fact, the percentage of Spillover Zone respondents citing noise as a problem decreased for all garbage-related activities *except* garbage trucks driving on the street. The most likely explanation for this is that trucks are likely to have been passing through the Spillover Zone in the minutes right before 6 a.m.

We addressed the topic of spillover collection noise as part of our discussion on noise effects in the previous chapter. However, it is worth reiterating some of the key findings.

Out of the 192 people responding to the pretest, 45 live in the Spillover Zone. Out of the 123 respondents to the posttest, only 33 live in the Spillover Zone. These small numbers can do little more than suggest possible trends.

Figure 5.1 suggests that for the most part, the expected spillover effects of increased garbage-related noise did not occur where we thought they would occur. There may in fact have been spillover noise generated by the haulers moving their nighttime operations elsewhere, but if so, this noise occurred outside the area we expected.

As Figure 5.1 shows, the percentage of Spillover Zone respondents citing noise as a problem decreased for all garbage-related activities *except* garbage trucks driving on the street. The percentage of respondents considering this a problem jumped by more than 100 percent, from 18 percent before the experimental program to 39 percent during. As we noted earlier, the most likely explanation for this is that as trucks move into the experimental area right at the first moment permitted during the experiment—6 a.m.—they move in greater numbers, many at the same time. They are likely to have been passing through the Spillover Zone in the minutes right before 6 a.m.

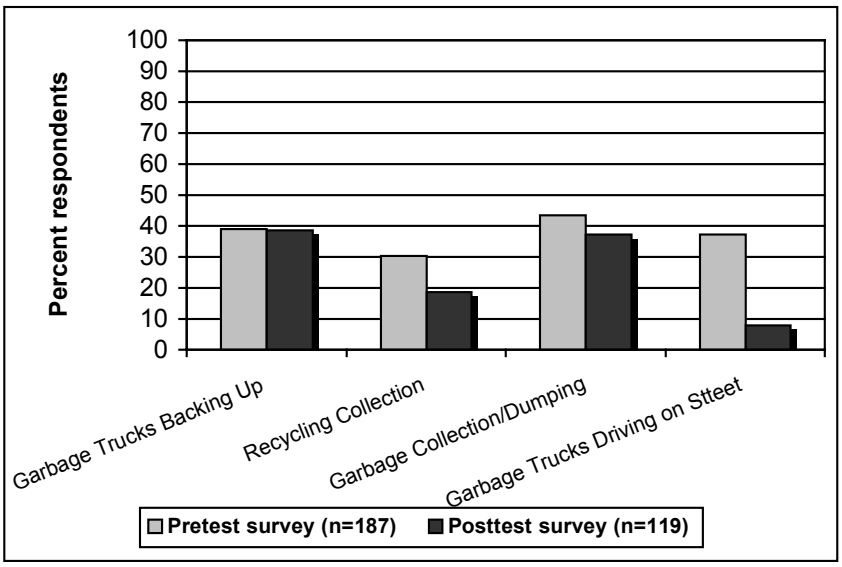


Figure 5.1. Percent of Spillover Zone respondents indicating that garbage-related noise sources are a problem, before and during the experiment. (Source: Northwest Livability Study, PSU 1999).

Traffic congestion

Traffic concerns

In general, traffic is a problem for a large percentage of the residents in Northwest Portland, especially those living in the densest, most intensely mixed-use districts. However, there was **no difference** in perceptions of traffic congestion among residents surveyed *before* and *during* the experimental program. In fact, some questions indicate that residents perceived traffic congestion as *less* of a problem during the experimental program.

The two most frequently cited sources of traffic congestion were the construction of the Central City Streetcar and the closure of the Lovejoy Street Ramp to the Broadway Bridge. Other source—including additional lanes on certain streets, seasonal and event traffic, and parking permit zones—all ranked above garbage trucks as a source of traffic congestion.

As noted, one consequence of the experimental program is that garbage collection trucks were on the road in Northwest Portland later in the day, when we expected that there would be a greater likelihood of conflicts with commuters and other vehicles. One anticipated spillover implication was therefore increased congestion, or at least an increase in residents' perception of congestion. In addition, the 6 a.m. restriction may have shifted early morning haulers to adjacent areas, where they would have quick access to the experimental program area once the time restriction ended. If so, this could have had an unintended impact on traffic congestion in the Spillover Zone.

Overall, traffic is a problem for nearly one half of residents living in the Commercial Core and the Spillover Zone (consisting primarily of the Pearl District), and one third of residents living in the In-Between areas (see Figure 5.2). This is not surprising, as the Commercial

Core and Pearl District generally have a higher activity level than do the In-Between areas, which consist primarily of residences. Only 29 percent of all businesses surveyed identified traffic as an overall problem. The already small sample size of the business survey makes it difficult to analyze business responses by zone.

During the experimental program, contrary to anticipated findings, residents' perceptions of traffic congestion *declined* slightly in the Commercial Core, although they did increase slightly in the Spillover areas. The In-Between areas remained relatively constant. The survey question, however, was not specific to traffic congestion caused by garbage collection; it is important to understand that any number of sources may be responsible for people's perceptions of traffic congestion.

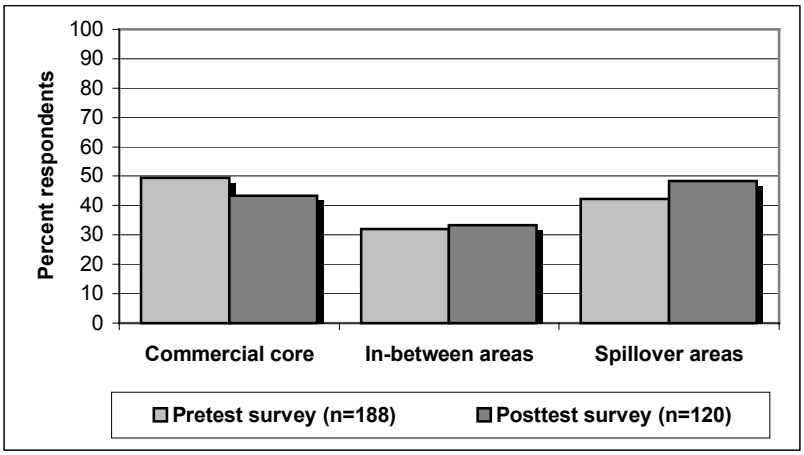


Figure 5.2. Percentage of resident respondents who agree that, overall, traffic is a problem in NW Portland. (Source: Northwest Livability Survey, PSU 1999).

Perceived sources of traffic congestion

The surveys asked residents to rank the top three factors that have made traffic "worse" or "better" over the past month. The results indicate that the presence of two major construction projects during the survey period—the Central City Streetcar and the demolition of the Lovejoy ramp—accounted for most concerns residents had regarding traffic congestion.

Of the residents who responded that traffic had gotten worse during the previous month, approximately 40 percent of the total responses (37 percent before the experimental program; 44 percent during) indicated "streetcar construction" as one of the top three reasons for this change (see Figure 5.3). Approximately 33 percent (29 percent before the experimental program; 37 percent during) indicated the "Lovejoy Ramp closure." In contrast, fewer than 5 percent of the total responses—both before and during the experimental program—identified "garbage trucks" as a major cause of worsening traffic.

Responses from business owners were similar: Of those who noticed worsening congestion, 90 percent of business respondents named the streetcar as one of the top three causes, and 72 percent named the Lovejoy Ramp. Only two business respondents (5 percent) identified garbage trucks as a primary cause of increasing congestion.

Given that these two projects—the Streetcar construction and Lovejoy Ramp removal—had such a great impact on people's perceptions of traffic congestion, it is possible that any changes caused by garbage trucks simply went unnoticed. This possibility makes it difficult to analyze spillover traffic implications that a change in collection times would cause, in terms of either sources of congestion or perceived levels of congestion.

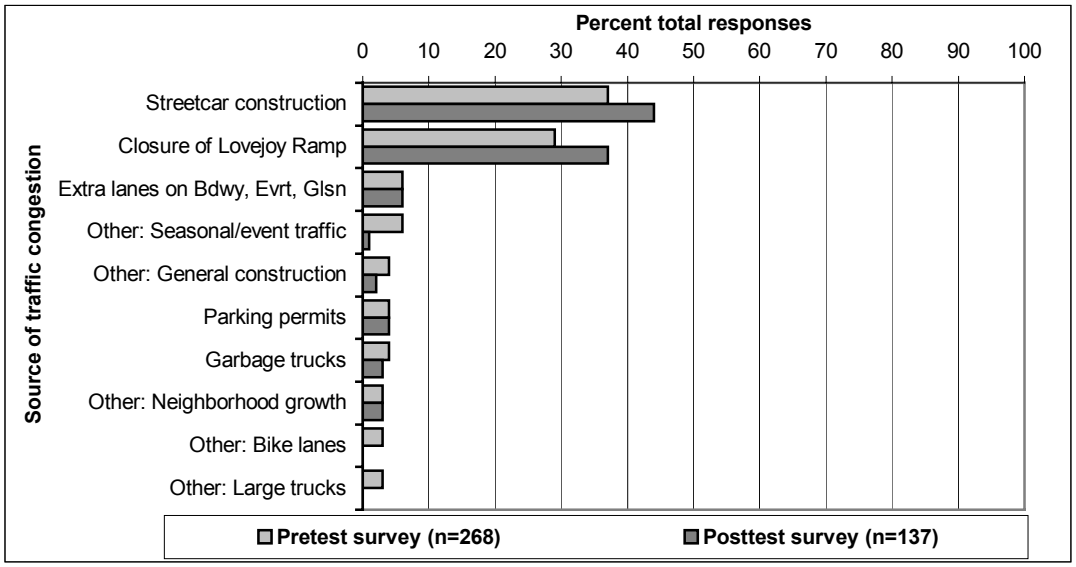


Figure 5.3. Percentage of total resident responses reporting that factor is one of the top three sources of worsened traffic congestion over the past month. (Source: Northwest Livability Survey, PSU 1999).

Perceived levels of traffic congestion

A potential indicator of the congestion impacts of the experimental program is whether residents perceived traffic congestion to have gotten worse during the time of the experimental program. However, again counter to our expectations, the share of residents who reported that traffic congestion had gotten worse over the past month was actually higher *before* the experimental program than during. In other words, a resident was more likely to have noticed worsening congestion before the experimental program began. These results are shown in Figure 5.4.

As portrayed in Figure 5.5, this general finding (that perceptions of worsening traffic were lower during the experimental program) also held true with respect to residents' perceptions of congestion in particular areas. Among all resident survey respondents, a smaller percentage reported that congestion on their street, on Northwest 23rd Avenue, or on Northwest 21st Avenue was a problem during the experimental program than before. Among business respondents, on the other hand, there was a slight increase in reported congestion problems at these three locations.

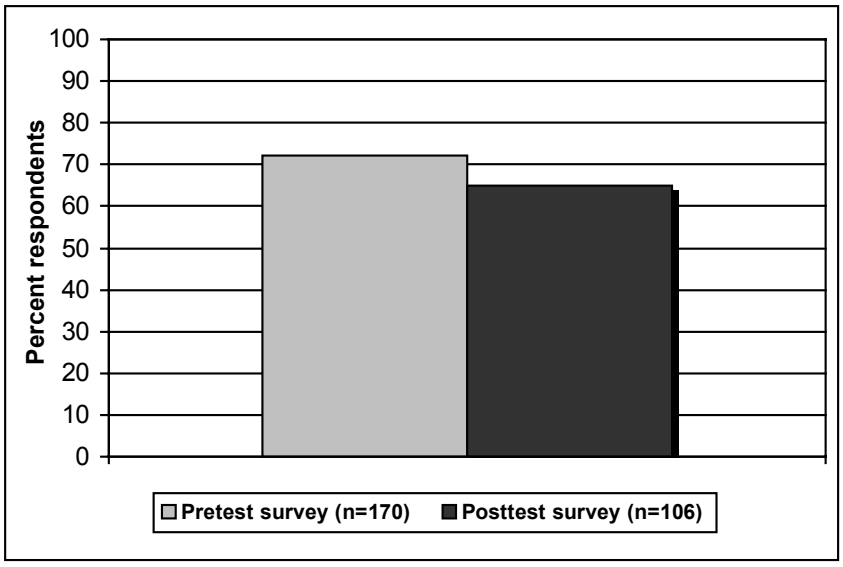


Figure 5.4. Percentage of residents who think traffic congestion has gotten worse over the past month. (Source: Northwest Livability Survey, PSU 1999).

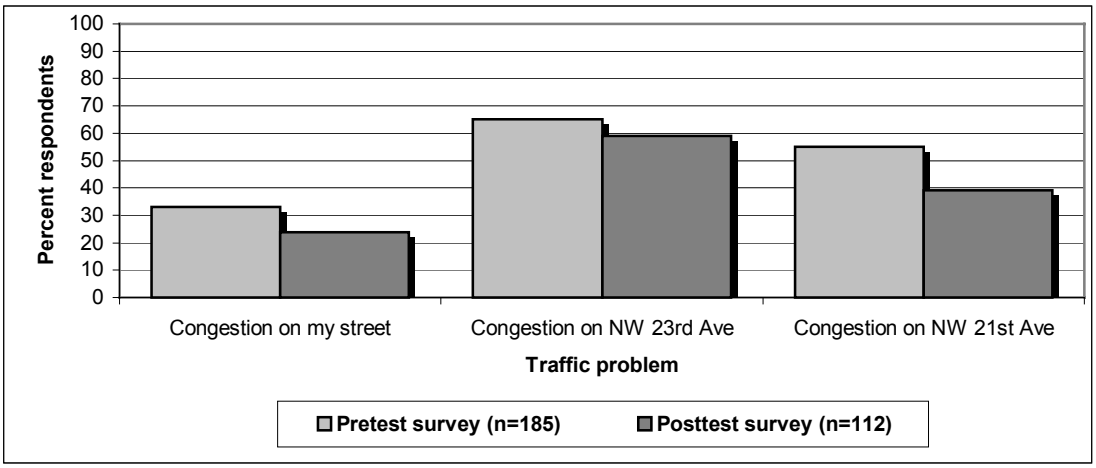


Figure 5.5. Share of resident respondents who reported that congestion was a problem at the given location. (Source: Northwest Livability Survey, PSU 1999).

Overall, the lack of strong, consistent shifts in perceptions of traffic congestion—either within the area of the experimental program or in nearby areas—could mean one of two things. First, it is possible that the experimental garbage collection time restrictions simply had no noticeable impact on traffic congestion in Northwest Portland. It could also mean, however, that even if the increased presence of garbage collection trucks did in fact worsen congestion (defined as decreased average travel speeds), people may have perceived any congestion that garbage trucks may have caused as minor relative to the congestion that larger, more pervasive sources (Central City Streetcar construction and closure of Lovejoy Ramp) caused.

Northwest neighborhood businesses

The study findings indicate that, in general, noise is not a high-priority concern among business owners. During the experimental program, there was an increase in concern over garbage collection noise from businesses outside of the Commercial Core, but the increase was very small.

Later trash collection may mean more hours of undisturbed sleep for residents, but for businesses, it means that trucks are more likely to be operating during normal business hours. This could have both traffic and noise implications for local businesses. In the previous section, we addressed the potential traffic implications, finding negligible impacts. Concerning noise, we expected that during the experimental program noise would become more of a problem for businesses.

In response to a question about general problems in Northwest Portland, 9 percent of all business respondents surveyed before the experimental program identified garbage collection noise as a problem. During the experimental program, this percentage rose to 22 percent. As part of the same question, 12 percent of all business respondents surveyed before the experimental program identified recycling collection noise as a problem, increasing to 26 percent during. These increases appear to be large, yet due to the small sample size this actually represents an increase of only two responses in each case. Nevertheless, it does suggest that there may have been an increased awareness of collection noise. It is interesting to note that in both cases the two additional responses came from outside of the Commercial Core, where we would not have expected the shift in collection times to have affected businesses.

The percentage of business respondents who were bothered by noise "in the last two weeks" increased from 20 percent before the experimental program to 57 percent for the posttest. However, no more than three respondents identified any of the garbage collection-related noises as a problem, either before or during the experimental program. This included "garbage trucks backing up (beeping)," "recycling collection (glass, etc.)," "garbage collection and dumping," and "garbage trucks driving on street." Only three respondents among all businesses named garbage or recycling collection as the first, second, or third most important source of disruptive noise "over the last two weeks."

Pricing effects

One aspect not studied due to methodological and experimental constraints, was the effect that a permanent time restriction on commercial garbage collection might have on both residential and commercial collection costs and, hence, increased prices for the consumer. This potential effect should be kept in mind.

It is important to note that a time restriction on garbage collection may cause an increase in residential and commercial garbage collection costs. Restrictions on times of collection may reduce the efficiency of operation. If so, it is likely that garbage haulers would increase their rates if their hours of operation remained restricted. Since current code does not provide for the City to regulate rates, haulers could presumably raise their rates

as necessary to cover their increased operating costs. The commercial clients of these haulers would then presumably pass the increased garbage-collection fees on to their customers in the form of higher prices. Changes in collection times may also create costs for the clients by interfering with other operations. Although it was beyond the scope of this study to measure these effects, they should be kept in mind.

Chapter

6

Findings with Respect to Sociodemographic Implications

➪ Chapter summary

In terms of sociodemographic characteristics, the residents responding to this survey appear to be representative of the overall population in Northwest Portland, especially compared with respondents to other surveys of this type.

Our findings suggest that there is a relationship between density and noise annoyance, with residents who live in denser areas being more likely to report noise as a problem. Our results also suggest that those who rate their neighborhood worse than other neighborhoods are far more likely to consider noise a problem than those who rate their neighborhood as better than or the same as other neighborhoods. Finally, younger adults are more likely to report being bothered by noise than are older adults, the majority of whom indicated it was either not a problem or, at worst, an inconvenience.

Sociodemographic profile of resident respondents

In general, the residents responding to this survey appear to be representative of the overall population in Northwest Portland, especially compared with respondents to other surveys of this type. The majority are younger adults (18 to 45), with at least some post high school education (although survey respondents were more likely than the population to have a graduate or professional degree). Respondents do tend to have higher incomes than the population overall, and they are somewhat more likely to be homeowners.

Identifying sociodemographic differences and similarities between the survey respondents and the larger population is critical in any survey research. Large variations may indicate that survey respondents—and their perceptions toward livability—are not representative of the Northwest neighborhood as a whole. In the following analyses, sociodemographic data for the Northwest neighborhood represents the "Northwest District Association" neighborhood and is based on 1996 American Community Survey data.[37] In general, the residents responding to this survey appear to be representative of the overall population in Northwest Portland, especially compared with respondents to other surveys of this type.

[37] Population data comes from the City of Portland, Office of Neighborhood Involvement Neighborhood Profiles, which compiled data based on the U.S. Census Bureau's 1996 American Community Survey.

Age

In each phase of the survey, the age distribution of resident respondents was similar to that of the larger Northwest District population—the majority in both cases being "younger adults" in the 18-to-40/45 age category. Figure 6.1 illustrates the distribution. The only noticeable difference is that pretest respondents were more likely than the overall population in Northwest to be "older adults"—aged 40 (or 45) to 64 (our survey broke down this age category to 45-64 years, while the Census Bureau used a broader range of 40-64).

Education

As Figure 6.2 indicates, in both phases, respondents were more likely than the general population to have some post-high school education or a graduate/professional degree and less likely to have a four-year college degree. The higher share of respondents with graduate/professional degrees is not surprising, as survey respondents are typically more likely to be more educated. The fact that respondents were more likely to have only some post high-school education is interesting. This may reflect to some degree Northwest Portland's elderly population, some of whom (in the 65+ age range) may not have attained higher levels of education, as is not unusual for the cohort of Americans born before World War II.

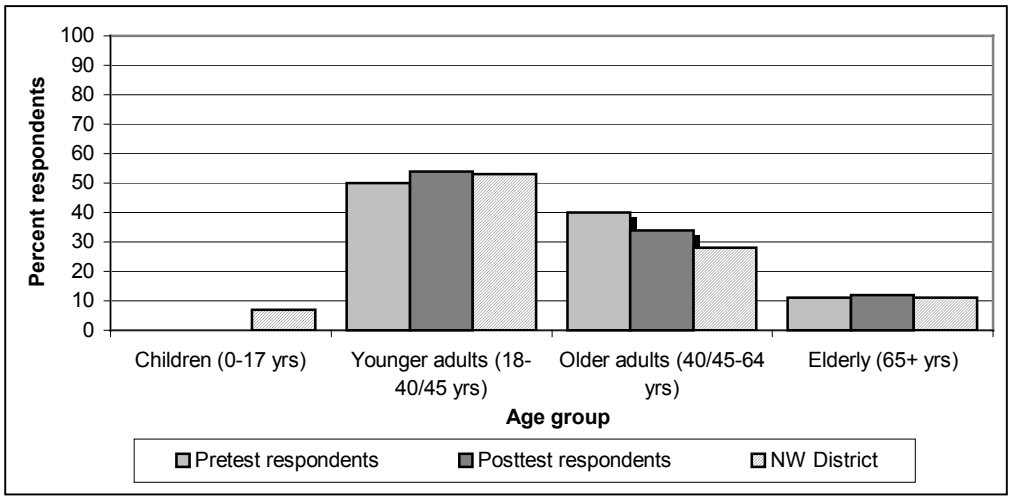


Figure 6.1. Age distribution of resident respondents relative to all NW District residents. (Sources: Northwest Livability Survey, PSU 1999; Neighborhood Profiles, City of Portland Office of Neighborhood Involvement 1996).

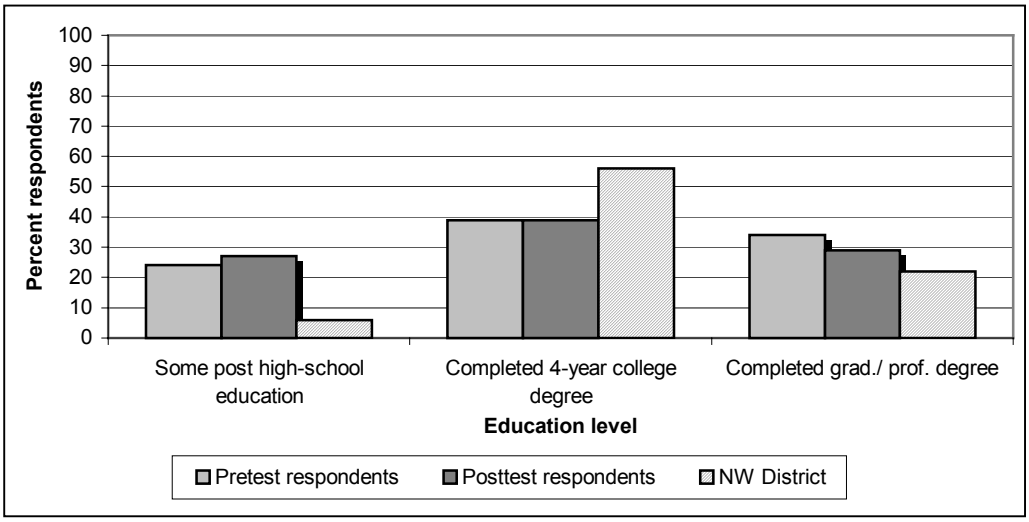


Figure 6.2. Education level of resident respondents relative to all NW District residents. (Sources: Northwest Livability Survey, PSU 1999; Neighborhood Profiles, City of Portland Office of Neighborhood Involvement 1996).

Income

Figure 6.3 illustrates that in both phases of the study, respondents were more likely to have higher annual household incomes ($45,000 or greater) than the rest of the population. This is typical for respondents to surveys of this type—those with greater incomes are often more financially vested in an area and therefore concerned about its long-term welfare. They may also have more discretionary time to spend on both survey taking and activism regarding neighborhood issues.

Housing tenure

Housing tenure status is shown in Figure 6.4. In both phases of the study, respondents were more likely to be homeowners than the rest of the population in Northwest Portland. This is also common for respondents to surveys of this type, as homeowners are often more emotionally and financially invested in their neighborhood and therefore more likely to be concerned about livability issues. But because the majority of Northwest Portland residents are renters, renters do make up the majority of respondents—72 percent for the pretest and 68 percent for the posttest.

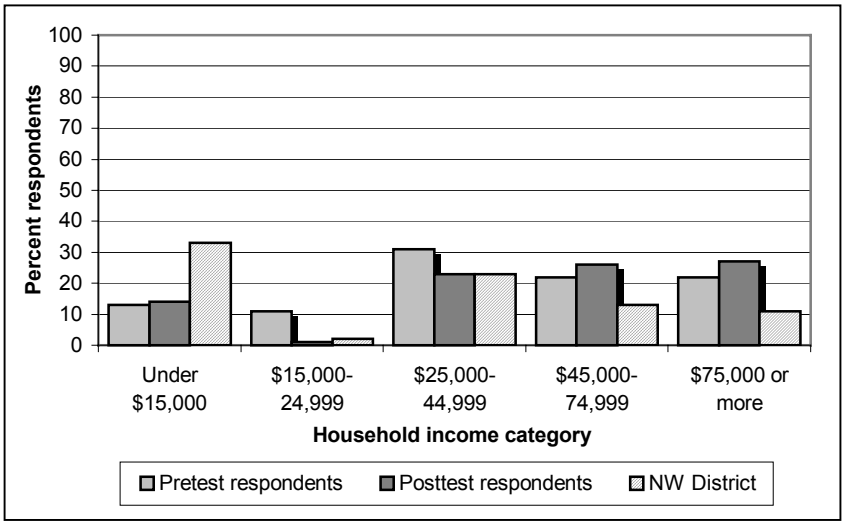


Figure 6.3. Approximate household income of resident respondents relative to all NW District residents. (Sources: Northwest Livability Survey, PSU 1999; Neighborhood Profiles, City of Portland Office of Neighborhood Involvement 1996).

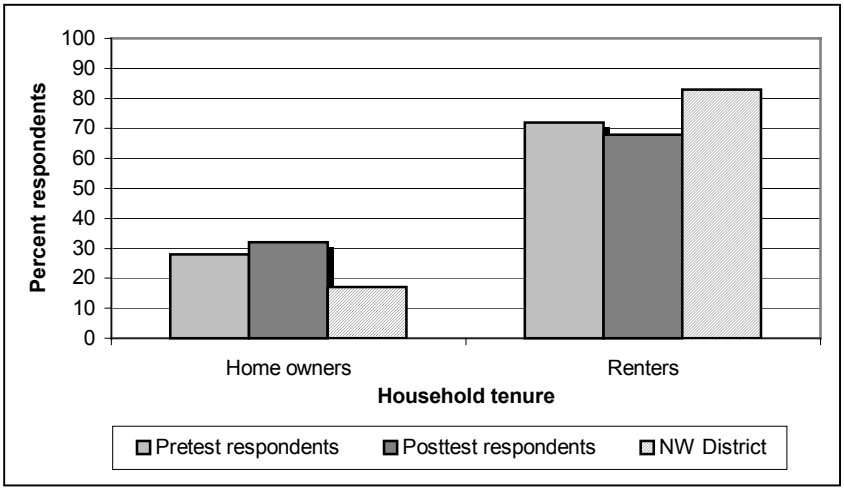


Figure 6.4. Housing tenure status of resident respondents relative to all NW District residents. (Sources: Northwest Livability Survey, PSU 1999; Neighborhood Profiles, City of Portland Office of Neighborhood Involvement 1996).

Length of residency in neighborhood

Although length of residency data was not available through the Northwest District Association neighborhood census data profiles, Figure 6.5 shows that the distribution

across survey phases was not different in any important ways. Although the share of residents who have lived in the neighborhood 2-5 years is slightly higher in the pretest, and the share who have lived here 0-1 years is slightly higher in the posttest, both categories represent fairly short-term residents. This difference should therefore not have any noticeable influence on the survey results. The greatest concern would be if a considerably larger share of long-term residents (10 years or more) responded to the pretest than to posttest, as these residents may have a different perception of the neighborhood that comes with time. Fortunately, this is not the case.

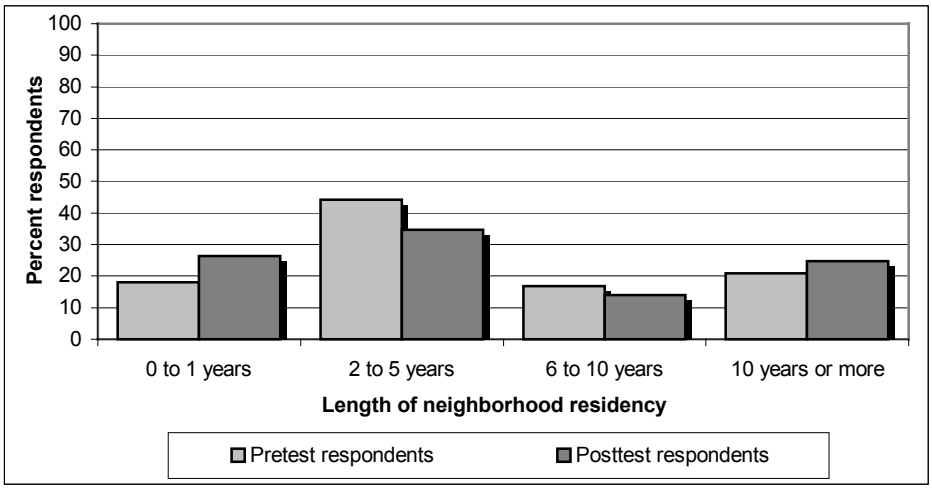


Figure 6.5. Distribution of the number of years resident respondents have lived in the NW District. (Source: Northwest Livability Survey, PSU 1999).

Sociodemographic implications

In line with previous research, our findings show that there is a relationship between density and noise annoyance, with residents who live in denser areas being more likely to report noise as a problem. Also in line with other research, our results suggest that those who rate their neighborhood worse than other neighborhoods are far more likely to consider noise a problem than those who rate their neighborhood as better than or the same as other neighborhoods. Finally, although some research suggests that the harmful effects of noise may be more severe for older adults, such research also suggests—as does ours—that younger adults are more likely to report being bothered by noise than are older adults, the majority of whom indicated it was either not a problem or, at worst, an inconvenience.

As with other research, our study did not find any particular relationship between noise annoyance and other sociodemographic factors, such as income, education, or profession

Previous research has suggested that the only sociodemographic variable related to noise annoyance is population density. Income and education have also shown some correlation, but the interpretation is problematic since the two are also related to each

other.[38] Other research has suggested a link between age and noise annoyance, but these findings have been ambiguous.[39] Housing tenure and length of residency in a neighborhood have not been shown to be correlated with noise annoyance, although satisfaction with neighborhood is correlated.[40]

We did not gather data on the specific density of the block on which the respondent lives, but we can provide a proxy by looking at the relationship between zone and whether or not respondents are bothered by noise. Table 6.1 shows the relationship between density (by zone) and noise annoyance. As expected, noise is most likely to be a problem in the higher density areas of the Commercial Core, Commercial Periphery, and Spillover Zone, while it is least likely to be a problem in the lower density area of the In-Between Zone.

Table 6.1. Density of residential zone by respondents' perception of noise as a problem (Source: Northwest Livability Survey, PSU 1999.)

Perception of Noise / Density	Noise is Not a Problem	Noise is an Inconvenience	Noise is a Problem	Total Percent
Commercial Core, Commercial Periphery, and Spillover Zones (highest densities)	19%	40%	41%	100%
In-Between Zone (lower densities)	42%	40%	18%	100%
Total count	70	122	144	306

Table 6.2 illustrates that there does appear to be some relationship between residents' perception of their neighborhood as better than, the same as, or worse than other neighborhoods and their perception of noise as a problem. Those who reported their neighborhood as being better than other neighborhoods were more inclined to see noise as not a problem or just an inconvenience rather than as a problem. Those who consider their neighborhood to be about the same as other neighborhoods appear to be equally as likely to consider noise to be not a problem, an inconvenience, or a problem. Finally, those who feel their neighborhood is worse than other neighborhoods are overwhelmingly more likely to consider noise as a problem. These findings are in line with those of other research.

[38] US Environmental Protection Agency, p. 78.
[39] Suter, p. 21; US Environmental Protection Agency, p. 19.
[40] US Environmental Protection Agency, pp. 24-25, 78.

Table 6.2. Respondents' perception of noise as a problem by perception of Northwest compared to other neighborhoods (Source: Northwest Livability Survey, PSU 1999.)

Perception of Noise / Perception of Northwest as a Place to Live	Noise is Not a Problem	Noise is an Inconvenience	Noise is a Problem	Total Percent
Better than other neighborhoods	22%	42%	36%	100%
Same as other neighborhoods	32%	35%	33%	100%
Worse than other neighborhoods	0%	21%	79%	100%
Total count	65	118	112	295

The research regarding the relationship between age and noise annoyance is somewhat ambiguous. On the one hand, the harmful effects of noise may be more severe for older adults;[41] on the other, younger adults may be more likely to report listening interference, startle or fright, or sleep interference.[42] Table 6.3 reflects some of this ambiguity. People 55 and older are not necessarily more likely to consider noise a problem. In fact, they are more likely to consider it an inconvenience or not a problem at all. The trend for the lower two age groups reflects what other research has shown about younger adults. In the lower age groups, the respondents are more likely than their elders to consider noise a problem, with the majority considering it at least an inconvenience, if not a problem.

Table 6.3. Respondents' perception of noise as a problem by age group (Source: Northwest Livability Survey, PSU 1999.)

Perception of Noise / Age Group	Noise is Not a Problem	Noise is an Inconvenience	Noise is a Problem	Total Percent
18 to 34 years old	25%	33%	42%	100%
35 to 54 years old	16%	36%	40%	100%
55 and older	31%	44%	25%	100%
Total count	68	121	112	301

[41] Suter, p. 21.
[42] US Environmental Protection Agency, p. 19.

Chapter
6

Conclusions

Survey findings

This study revealed that while Northwest Portland residents continue to be, on the whole, very satisfied with the quality of life in their neighborhood, there continue to be a number of nuisances that detract from that quality of life. Perhaps ironically, the aspects of the neighborhood that residents find attractive—its proximity to and diversity of activities—also result in characteristics that can make an urban environment unpleasant for some.

As in our 1994 study, we found that the lack of parking continues to be a primary problem for Northwest residents. Crime, traffic, and the presence of homeless people also detract from the neighborhood's appeal. It is important for residents and policy-makers to keep in mind that while people do consider various sources of urban noise to be bothersome, they still tend to rank the lack of parking, crime, and traffic as more bothersome.

However, noise ("unwanted sound") appears to be bothersome in a way that is more *annoying* than other urban problems. Why? Perhaps its especially annoying nature lies in the fact that many types of urban noise are not only constant and repetitive, but at a high enough frequency, decibel level, or intensity to effect physical and emotional stress on a very regular basis. In addition, they are often unpredictable. Who knows when a car alarm is going to go off, how long it will last, and when it will happen again? Also, because noise—particularly early-morning noise—can disrupt sleep, it can affect people's mood and performance level.

When we controlled for the other bothersome factors in the urban environment and focused only on noise, the four top sources of noise were anti-theft alarms, people outside talking or shouting, garbage collection and dumping, and neighborhood traffic. During the experimental program, which altered the timing of garbage collection in this neighborhood, a smaller percentage of survey respondents cited garbage-related noise as a problem and a smaller percentage ranked garbage-related noise as a primary source of sleep disruption.

It is important to bear in mind, however, that these findings do not suggest a cause-and-effect relationship. It would be inaccurate to conclude that the change in the timing of garbage collection *caused* a reduction in bothersome noise. It is always problematic to find a causal relationship in social science research. In most cases, it is more appropriate to try to determine correlations, or relationships, between phenomena. However, in order to be fairly certain that such relationships are not the result of pure chance, the laws of probability require that researchers usually have fairly large sample size. Our sample size was, in most cases, too small for us to conclude that our findings were not just the result of pure chance. Even if we had had twice, three times, four times the sample size, however,

we could not legitimately conclude that the change in the timing of the garbage collection *caused* a decrease in bothersome urban noise.

Common sense, however, is as important a determinant of public policy as statistical significance—if not more so. And in this case, common sense tells us that it is probable that the change in the garbage collection times did reduce bothersome urban noise. Nothing in the findings suggests that this is unlikely to be the case. We also found that some of the undesirable spillover effects we expected did not occur as we thought they would, but we really do not know why. Perhaps the construction of the Central City Streetcar and the removal of the Lovejoy Ramp rated so high as sources of traffic congestion that people barely noticed the changes in traffic, if any, due to garbage trucks being on the streets at unusual times. Perhaps spillover effects were not pronounced in the Pearl District because the garbage haulers did not divert their activities to that neighborhood. And, of course, we have no idea what the pricing effects would be if the timing were changed permanently.

This study faced several challenges that make an interpretation of its findings subject to caution. In addition to the small sample size, the experimental design had garbage collection resume at 6 a.m. Several findings of our research suggest that this cutoff time was too early to have effects as profound as we might have seen with a 7 or 8 a.m. cutoff time.

Policy implications

Urban noise—unwanted sound in urban areas—continues to spread and increase in intensity. There are many sources of urban noise, and, like other types of pollution, the sources and the effects are difficult to control.

Noise pollution, unlike air or water pollution, does not lead to catastrophic (i.e., life-threatening) health problems. It can, however, cause or exacerbate noncatastrophic health problems, including cardiovascular disease, loss of hearing, and increased stress—particularly due to lack of sleep. In many ways, it is a more apparent indicator of quality of life than other types of pollution, because its annoying effects are immediate.

Many national governments have become involved in addressing urban noise pollution. In the United States, the federal government's involvement was short lived, from the early 1970s to 1981. This left the burden for noise abatement to local jurisdictions. Because noise pollution, unlike air and water pollution, does not generally cross local jurisdictional boundaries, the relegation of the problem to local governments has not easily been contested. But many local governments do not have the resources to measure and address noise. In some cases, urban noise is generated by sources that fall completely outside of the local government's authority (e.g., air traffic noise).

Portland, Oregon, is typical of many U.S. cities in having few noise control enforcement resources. As the city continues to grow, however, residents and city leaders have begun calling for more research and more resources to control urban noise. This report, the second of its kind in less than a decade, as well as a recently formed Noise Mitigation Task Force, signal growing concern with formulating and enacting new noise control policy.

The challenges for policy formulation and implementation in the area of noise mitigation are great. As this report has indicated, some of the sources of the most annoying types of noise—antitheft alarms and loud people—may be difficult if not impossible to regulate. It may be possible, however, to regulate other sources of noise such as that generated by garbage collection, delivery trucks, and buses.

The most common method of addressing unwanted by-products of urban activities (i.e., negative externalities) is through taxation or regulation. The City could, for example, tax garbage haulers and private trucks when their activities exceed certain decibel limits. Or the City could regulate the hours at which these businesses operate, the type of equipment they use, the areas in which they may operate, and so on. In either case—taxation or regulation—it is important for policy-makers to be aware of the political costs. In many cases, the costs of taxation or regulation may be borne by the end user—the customer or apartment dweller—in the form of higher prices and rents.

Policy-makers' experience with regulation and taxation of other types of pollution such as air and water reveals that a cooperative, consensus-based approach to mitigation is more effective over the long term than a punitive or adversarial approach. We also know that top-down punitive and adversarial environmental policy is likely to result in enforcement through litigation, an expensive and inefficient means of implementation. This report urges local policy-makers to adopt a cooperative, consensus-based approach. Delays at the outset that are an inevitable result of negotiation and dialogue are outweighed in the long term by successful policy implementation.

The fact that urban noise complaints in the Portland area are frequently generated by residents of high-density, mixed use neighborhoods further underscores the importance of a cooperate, consensus-based approach. The City of Portland, in line with regional and state planning objectives, has embraced a goal of central city densification and mixing of land uses. While research suggests that high-density, mixed use development may enhance a sense of community and decrease total vehicle miles traveled, and as a result, air and water pollution, this type of development has also been shown to result in an intensification of other disamenities—noise pollution among them.

The challenge, therefore, is for local policy-makers to balance their planning vision of increased density and mixed land uses with that of economic vitality. Northwest Portland is an excellent example of a neighborhood that thrives precisely because it has density and mixed land uses. There is a symbiotic relationship between the residents and the businesses in the area, but this relationship is increasingly precarious. The needs and demands of the residents conflict with the needs and demands not only of businesses but of other residents in the area.

A simple example will illustrate the delicate nature of this relationship. Suppose that commercial garbage haulers were permanently restricted from collection in mixed-use neighborhoods between 10 p.m. and 7 a.m. For these haulers to maintain efficient and profitable operations, they would likely have to increase their prices, which would in turn probably be passed on to their customers, who would in turn probably pass them on to their clientele and renters. It is impossible to predict if and when a price would be reached that would result in an "optimum" quality of life for all—where garbage-collection noise is not bothersome and at the same time, the neighborhood remains affordable enough to attract the diversity of residents and businesses that makes it desirable.

In fact, there is a point at which the price increase would presumably be high enough to discourage businesses from operating in the neighborhood. Simultaneously, there is a point at which rent increases would presumably discourage people from living in Northwest. Economic balance points are impossible to predict. This is another reason why cooperative and consensus-based policy-making should characterize the process of addressing urban noise. Through collaborative dialogue, the parties involved (residents, garbage haulers, city officials) can negotiate compromise and cooperation, rather than risk the political fallout of top-down, adversarial punitive regulation and/or taxation. The potential parties in this process have already demonstrated their willingness and ability to work together in this fashion, through the creation of the steering committee that brought about the present study.

It is crucial, therefore, that if the public and the City choose to address urban noise, the City establish a cooperative, consensus-based framework for doing so, not just to address problems with noise that currently exist, but those that are bound to intensify in the future as the city and the region grow.

In conclusion, the findings of this research suggest that changing the time of garbage collection in mixed-use areas such as Northwest Portland so that it is prohibited between at least 10 p.m. and 6 a.m., if not 7 or 8 a.m., is very likely to improve the quality of life associated with garbage-related noise. We know that garbage-collection noise is annoying—profoundly so—for some residents in Northwest Portland. Whether this noise profoundly annoys a significant enough percentage of the residents to warrant governmental intervention is a question that this report cannot answer. However, we know that urban noise pollution, from a variety of sources, is likely only to worsen as densities and mixing of land uses increase. It is important to remember, though, that other problems associated with dense urban living are equally likely to worsen and that the public may consider some of these as even greater problems than noise. It is for the public and policy-makers to prioritize the targets of problem solving.

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Appendix A: Sample Residential Survey

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Appendix B: Distribution of resident responses to what makes Northwest Portland a good place to be right now

		"Agree" responses		Neutral		"Disagree" responses	
		Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
The mix of people living here							
	Commercial Core	64.2	73.5	29.5	17.0	6.3	9.5
	In-between areas	62.5	62.8	31.3	20.0	6.2	17.2
	Spillover areas	80.9	71.0	16.7	22.6	2.4	6.4
Economic health							
	Commercial Core	68.1	62.8	28.7	35.3	3.2	1.9
	In-between areas	72.3	90.9	23.4	9.1	4.3	0.0
	Spillover areas	83.3	80.0	11.9	16.7	4.8	3.3
Quality of stores							
	Commercial Core	84.4	73.1	6.3	19.2	9.3	7.7
	In-between areas	83.7	75.0	8.2	22.2	8.1	2.8
	Spillover areas	75.5	61.3	15.6	35.5	8.9	3.2
Range of activities							
	Commercial Core	77.7	84.9	19.1	13.2	3.2	1.9
	In-between areas	83.3	74.2	12.5	22.9	4.2	2.9
	Spillover areas	82.2	80.6	15.6	16.1	2.2	3.3
Night life activities							
	Commercial Core	63.2	72.0	26.3	18.0	10.5	10.0
	In-between areas	68.1	67.7	23.4	14.7	8.5	17.6
	Spillover areas	56.8	68.9	36.4	20.7	6.8	10.4
The ability to walk to activities							
	Commercial Core	97.9	94.2	1.0	5.8	1.1	0.0
	In-between areas	98.0	94.4	2.0	5.6	0.0	0.0
	Spillover areas	97.6	96.6	0.0	0.0	2.4	3.4
Strong sense of community							
	Commercial Core	54.3	51.0	29.8	39.2	15.9	9.8
	In-between areas	45.7	51.5	30.4	39.4	23.9	9.1
	Spillover areas	61.3	50.0	34.1	40.0	4.6	10.0
Attractive architecture							
	Commercial Core	81.9	78.5	13.8	19.6	4.3	1.9
	In-between areas	89.6	72.7	6.3	18.2	4.1	9.1
	Spillover areas	75.5	74.2	20.0	22.6	4.5	3.2
Safe night-time environment							
	Commercial Core	63.4	63.2	16.1	24.5	20.5	12.3
	In-between areas	71.8	60.6	10.9	24.2	17.3	15.2
	Spillover areas	53.5	56.6	25.6	16.7	20.9	26.7

Continued

Ability of people to live AND work here							
	Commercial Core	68.9	82.0	24.7	14.0	6.4	4.0
	In-between areas	73.9	71.4	23.9	20.0	2.2	8.6
	Spillover areas	78.0	73.3	17.1	23.3	4.9	3.4
Close proximity to downtown							
	Commercial Core	94.8	98.0	4.2	0.0	1.0	2.0
	In-between areas	89.8	91.7	10.2	8.3	0.0	0.0
	Spillover areas	90.9	100.0	6.8	0.0	2.3	0.0
Affordable rents							
	Commercial Core	17.3	26.9	19.6	25.0	63.1	48.1
	In-between areas	21.7	14.7	21.7	23.5	56.6	61.8
	Spillover areas	18.6	27.6	25.6	13.8	55.8	58.6
Good real estate investment							
	Commercial Core	41.1	40.4	45.6	42.6	13.3	17.0
	In-between areas	33.3	50.0	47.6	42.9	19.1	7.1
	Spillover areas	42.1	44.4	42.1	37.0	15.8	18.6
People like me live here							
	Commercial Core	59.2	57.5	30.1	40.4	10.7	2.1
	In-between areas	60.4	60.0	37.5	28.6	2.1	11.4
	Spillover areas	53.5	41.4	41.9	48.3	4.6	10.3
Close proximity to Forest Park							
	Commercial Core	60.5	73.5	34.1	22.4	5.4	4.1
	In-between areas	71.1	81.3	26.7	12.5	2.2	6.2
	Spillover areas	57.8	58.1	35.6	35.5	6.6	6.4

Appendix C: Distribution of resident responses to factors that some people see as neighborhood problems

		Not a Problem		Inconvenience		"Problem" responses	
		Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
Too many outsiders using the area							
	Commercial Core	23.7	35.3	39.8	39.2	36.5	25.5
	In-between areas	31.9	36.4	42.6	48.5	25.5	15.1
	Spillover areas	45.2	37.9	35.7	41.4	19.1	20.7
Too much traffic							
	Commercial Core	12.5	5.7	21.9	32.1	65.6	62.2
	In-between areas	8.0	14.3	38.0	37.1	54.0	48.6
	Spillover areas	4.5	13.3	36.4	20.0	59.1	66.7
Too little parking							
	Commercial Core	8.3	5.7	11.5	20.8	80.2	73.5
	In-between areas	2.0	11.4	20.0	20.0	78.0	68.6
	Spillover areas	6.7	3.1	20.0	15.6	73.3	81.3
Conflicts between pedestrians and vehicles							
	Commercial Core	22.8	25.0	21.7	26.9	55.5	48.1
	In-between areas	22.9	8.6	26.9	22.9	50.2	68.5
	Spillover areas	11.9	13.3	45.2	30.0	42.9	56.7
Hard to find basic goods							
	Commercial Core	61.3	73.6	24.7	11.3	14.0	15.1
	In-between areas	66.7	60.0	18.8	25.7	14.5	14.3
	Spillover areas	56.8	43.8	15.9	12.5	27.3	43.7
Too many bars							
	Commercial Core	71.9	67.3	12.4	13.5	15.7	19.2
	In-between areas	79.6	71.9	8.2	15.6	12.2	12.5
	Spillover areas	73.2	75.0	12.2	14.3	14.6	10.7
Garbage collection noise							
	Commercial Core	21.3	25.0	27.7	28.8	51.0	46.2
	In-between areas	40.8	38.9	22.4	30.6	36.8	30.5
	Spillover areas	24.4	37.9	44.4	20.7	31.2	41.4
Night life noise							
	Commercial Core	33.0	51.9	34.0	28.8	33.0	19.3
	In-between areas	62.5	48.6	16.7	31.4	20.8	20.0
	Spillover areas	40.9	33.3	36.4	37.0	22.7	29.7
Auto theft and break-ins							
	Commercial Core	19.0	17.0	7.1	12.8	73.9	70.2
	In-between areas	9.3	9.7	9.3	6.5	81.4	83.8
	Spillover areas	10.5	10.0	15.8	10.0	73.7	80.0

Continued

Recycling collection (glass, etc)							
	Commercial Core	56.5	56.3	15.2	18.8	28.3	24.9
	In-between areas	70.8	62.1	12.5	20.7	16.7	17.2
	Spillover areas	52.5	58.6	27.5	17.2	20.0	24.2
Vandalism							
	Commercial Core	19.3	21.3	23.9	21.3	56.8	57.4
	In-between areas	10.6	23.3	14.9	6.7	74.5	70.0
	Spillover areas	9.5	17.2	16.7	10.3	73.8	72.5
Street drinking							
	Commercial Core	30.8	34.0	29.7	23.4	39.5	42.6
	In-between areas	37.0	31.3	15.2	18.8	47.8	49.9
	Spillover areas	14.3	27.6	23.8	24.1	61.9	48.3
Traffic noise							
	Commercial Core	18.1	15.4	37.2	46.2	44.7	38.4
	In-between areas	24.5	29.4	38.8	29.4	36.7	41.2
	Spillover areas	11.1	9.7	44.4	35.5	44.5	54.8
Presence of homeless people							
	Commercial Core	12.6	23.5	40.0	31.4	47.4	45.1
	In-between areas	17.4	26.5	23.9	38.2	58.7	35.3
	Spillover areas	6.7	31.3	42.2	28.1	51.1	40.6

Appendix D: Distribution of resident responses to sources of bothersome noise over the past two weeks

		Not a Problem		Inconvenience		"Problem" responses	
		Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
Traffic in the neighborhood							
	Commercial Core	12.8	20.9	33.3	41.9	53.9	37.2
	In-between areas	27.8	22.2	38.9	40.7	33.3	37.1
	Spillover areas	21.2	20.0	39.4	32.0	39.4	48.0
Buses							
	Commercial Core	53.2	78.0	20.8	12.2	26.0	9.8
	In-between areas	51.4	66.7	27.0	22.2	21.6	11.1
	Spillover areas	51.4	54.2	22.9	29.2	25.7	16.6
Garbage trucks backing up							
	Commercial Core	19.7	18.2	27.6	40.9	52.7	40.9
	In-between areas	36.1	34.6	25.0	26.9	38.9	38.5
	Spillover areas	25.7	34.8	37.1	34.8	37.2	30.4
Freeway noise							
	Commercial Core	84.4	85.4	9.1	4.9	6.5	9.7
	In-between areas	83.3	76.0	8.3	16.0	8.4	8.0
	Spillover areas	65.6	82.6	28.1	8.7	6.3	8.7
Noisy neighbors							
	Commercial Core	51.3	45.5	16.7	27.3	32.0	27.2
	In-between areas	54.1	68.0	29.7	12.0	16.2	20.0
	Spillover areas	48.6	40.9	34.3	31.8	17.1	27.3
Recycling collection							
	Commercial Core	37.7	35.7	18.2	21.4	44.1	42.9
	In-between areas	38.9	55.6	30.6	25.9	30.5	18.5
	Spillover areas	40.0	63.6	28.6	22.7	31.4	13.7
Loud people outside							
	Commercial Core	13.8	15.9	36.3	43.2	49.9	40.9
	In-between areas	18.9	24.0	32.4	32.0	48.7	44.0
	Spillover areas	22.9	33.3	34.3	25.0	42.8	41.7
Garbage collection/dumping							
	Commercial Core	19.2	17.1	26.9	31.7	53.9	51.2
	In-between areas	29.7	37.0	27.0	25.9	43.3	37.1
	Spillover areas	20.6	40.9	41.2	22.7	38.2	36.4
Industrial noise							
	Commercial Core	67.9	76.2	14.1	7.1	18.0	16.7
	In-between areas	75.7	80.8	18.9	3.8	5.4	15.4
	Spillover areas	67.6	59.1	17.6	13.6	14.8	27.3

Continued

Construction noise							
	Commercial Core	48.7	56.1	20.5	19.5	30.8	24.4
	In-between areas	44.4	63.0	19.4	22.2	36.2	14.8
	Spillover areas	38.2	58.3	26.5	8.3	35.3	33.4
Anti-theft alarms							
	Commercial Core	14.6	2.3	28.0	52.3	57.4	45.4
	In-between areas	14.3	14.8	34.3	37.0	51.4	48.2
	Spillover areas	8.8	16.7	55.9	37.5	35.3	45.8
Homeless people making noise							
	Commercial Core	24.7	33.3	37.7	42.9	37.6	23.8
	In-between areas	33.3	48.0	30.6	28.0	36.1	24.0
	Spillover areas	25.7	52.2	54.3	26.1	20.0	21.7
Garbage trucks driving on street							
	Commercial Core	26.3	33.3	32.9	33.3	40.8	33.4
	In-between areas	31.3	56.0	31.6	36.0	37.1	8.0
	Spillover areas	24.2	30.4	57.6	30.4	18.2	39.2
Delivery trucks							
	Commercial Core	42.9	46.5	26.0	23.3	31.1	30.2
	In-between areas	48.6	46.2	32.4	30.8	19.0	23.0
	Spillover areas	51.5	40.0	33.3	12.0	15.2	48.0

Appendix E: Resident respondents' ranking of the Top 3 sources of sleep-disturbing noise over the past two weeks

	Total		Number 1 source		Number 2 source		Number 3 source	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
Commercial core[1]								
Traffic in the neighborhood	12.5	13.3	2.1	5.7	5.2	3.8	5.2	3.8
Buses	4.2	1.9	2.1	1.9	0.0	0.0	2.1	0.0
Garbage trucks backing up	12.3	24.5	1.0	5.7	3.1	11.3	8.2	7.5
Freeway noise	2.0	1.9	1.0	1.9	1.0	0.0	0.0	0.0
Noisy neighbors	10.3	18.8	5.2	11.3	4.1	0.0	1.0	7.5
Loud people outside	22.8	22.6	12.4	5.7	5.2	9.4	5.2	7.5
Recycling collection	16.5	22.6	3.1	9.4	9.3	7.5	4.1	5.7
Garbage collection/dumping	23.7	32.0	13.4	13.2	7.2	11.3	3.1	7.5
Industrial noise	4.1	1.9	1.0	0.0	2.1	1.9	1.0	0.0
Construction noise	8.3	9.4	5.2	7.5	1.0	0.0	2.1	1.9
Anti-theft alarms	15.5	15.2	3.1	3.8	5.2	5.7	7.2	5.7
Homeless people making noise	9.3	9.5	2.1	1.9	4.1	3.8	3.1	3.8
Garbage trucks driving on street	2.1	9.5	0.0	0.0	0.0	3.8	2.1	5.7
Delivery trucks	5.2	5.7	1.0	0.0	2.1	1.9	2.1	3.8
In-between areas[2]								
Traffic in the neighborhood	6.0	18.4	0.0	2.6	4.0	5.3	2.0	10.5
Buses	8.0	2.6	4.0	0.0	0.0	2.6	4.0	0.0
Garbage trucks backing up	6.0	0.0	0.0	0.0	2.0	0.0	4.0	0.0
Freeway noise	0.0	2.6	0.0	0.0	0.0	0.0	0.0	2.6
Noisy neighbors	8.0	5.3	2.0	5.3	2.0	0.0	4.0	0.0
Loud people outside	24.0	23.7	12.0	15.8	2.0	2.6	10.0	5.3
Recycling collection	14.0	5.3	6.0	0.0	4.0	5.3	4.0	0.0
Garbage collection/dumping	22.0	15.8	10.0	7.9	10.0	7.9	2.0	0.0
Industrial noise	0.0	2.6	0.0	0.0	0.0	0.0	0.0	2.6
Construction noise	12.0	0.0	10.0	0.0	2.0	0.0	0.0	0.0
Anti-theft alarms	12.0	18.4	4.0	2.6	8.0	5.3	0.0	10.5
Homeless people making noise	14.0	5.2	4.0	0.0	6.0	2.6	4.0	2.6
Garbage trucks driving on street	6.0	2.6	0.0	0.0	0.0	2.6	6.0	0.0
Delivery trucks	4.0	10.5	2.0	10.5	0.0	0.0	2.0	0.0

Continued

Spillover areas[3]								
Traffic in the neighborhood	15.5	18.9	2.2	6.3	2.2	6.3	11.1	6.3
Buses	6.6	9.4	4.4	6.3	2.2	3.1	0.0	0.0
Garbage trucks backing up	8.8	6.3	4.4	0.0	4.4	0.0	0.0	6.3
Freeway noise	0.0	6.3	0.0	0.0	0.0	0.0	0.0	6.3
Noisy neighbors	4.4	12.5	4.4	6.3	0.0	3.1	0.0	3.1
Loud people outside	22.2	25.1	8.9	9.4	8.9	6.3	4.4	9.4
Recycling collection	17.8	6.3	6.7	6.3	0.0	0.0	11.1	0.0
Garbage collection/dumping	22.3	6.2	6.7	3.1	6.7	3.1	8.9	0.0
Industrial noise	0.0	6.2	0.0	0.0	0.0	3.1	0.0	3.1
Construction noise	15.5	6.2	2.2	0.0	8.9	3.1	4.4	3.1
Anti-theft alarms	11.0	21.8	2.2	3.1	4.4	15.6	4.4	3.1
Homeless people making noise	17.8	9.4	2.2	6.3	6.7	0.0	8.9	3.1
Garbage trucks driving on street	0.0	6.2	0.0	0.0	0.0	3.1	0.0	3.1
Delivery trucks	4.4	9.4	0.0	6.3	2.2	3.1	2.2	0.0

[1] n = 96 (pretest), 53 (posttest); [2] 50 (pretest), 38 (posttest); [3] n = 45 (pretest), 32 (posttest)