Living in Boston During COVID-19: Fear and Ambivalence
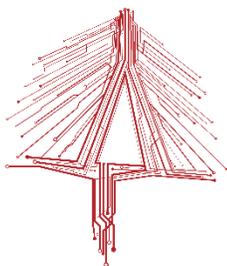
Report #2 in a Series

Partnering Institutions

The Boston Area Research Initiative is an interuniversity partnership based at Northeastern University that convenes researchers, policymakers, practitioners, and community leaders to envision and realize the future of the city. Our primary goal is to leverage data and technology to better understand and serve cities, with a focus on enhancing equity, justice, and democracy.

The Center for Survey Research (CSR) at the University of Massachusetts Boston is a full-scale academic survey research center. CSR conducts basic and applied research that contributes to knowledge and understanding of important social issues and supports public and private agencies and university scholars in carrying out high quality policy-related research. Its projects include Beacon, a panel study on Boston neighborhoods.

Boston Public Health Commission, the country's oldest health department, is an independent public agency providing a wide range of health services and programs. Public service and access to quality health care are the cornerstones of our mission—to protect, preserve, and promote the health and well-being of all Boston residents, particularly those who are most vulnerable.

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Executive Summary

In the Summer of 2020, the Boston Area Research Initiative (BARI) at Northeastern University, the Center for Survey Research (CSR) at University of Massachusetts Boston, and the Boston Public Health Commission (BPHC) conducted a survey that captures the experiences of 1626 Bostonians during the first months of the COVID-19 pandemic, including: their ability and tendency to follow social distancing recommendations; attitudes towards regulations; and the economic and personal impacts of the pandemic. The survey provides unique insights into how these factors varied across the populations and neighborhoods of a single city—something not currently available from any other source, in Boston or otherwise.

In this second report, we describe what we see as contrasting themes of fear and ambivalence among Bostonians. On the one hand, there appears to be broad consensus that the virus is dangerous, that social distancing guidelines are important, that masks should be worn and high-risk activities avoided, and that asymptomatic spread is a concern. However, there was much deviation from this consensus, and these views varied substantially by neighborhood, race, and income. This variation can help us to understand the vulnerabilities that different communities face as cases surge this winter.

Main Findings

- **Most people said they were doing the right thing, but things have loosened up since April.** Although mask-wearing increased from April to the summer, the proportion of respondents visiting with others indoors nearly doubled between April and the Summer (31% vs. 55%). Similarly, 19% of people attended a gathering of 10 or more people in the previous week in the Summer, up from 4% in April. This makes sense given the reopening of society, but bears watching as cases trend upward.
- **Attitudes about risk, social distancing guidelines, and masks varied considerably by neighborhood and ethnicity**, with neighborhoods on the east coast of the city (South Boston, Seaport, North Dorchester, North End) expressing the least support for these notions. Black and Asian respondents most consistently saw greater risk of exposure to infection and greater importance for social distancing guidelines, whereas there were more White respondents who expressed ambivalence.
- **The frequency of discretionary, high-risk behaviors varied considerably by neighborhood, tracking closely with attitudes.** Activities like visiting with others

indoors and going out or attending gatherings were highest among residents of neighborhoods on the east coast of the city, like South Boston and the North End.

- **Though they were a minority, about one in six people were unaware or uncertain that COVID-19 could be transmitted by asymptomatic individuals.** This tracked tightly with income levels, with over 25% of individuals making less than $30,000/yr. saying that asymptomatic spread was possible, compared to less than 5% of those making over $75,000/yr.

Conclusions and Next Steps

The distributions of attitudes and behaviors we see here reveal different vulnerabilities for different types of communities. Whereas some White and more affluent neighborhoods may be taking greater liberties with high-risk behaviors and seeing less value in social distancing, low-income, majority-minority neighborhoods seem to have more individuals who do not understand the science of asymptomatic spread. This suggests specific, targeted ways that public officials might communicate with each of these communities, supporting them in the months ahead as cases continue to grow.

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1. Living in Boston during COVID-19: A Neighborhood Survey

The NSF-Beacon survey captures the experiences of 1626 Bostonians during the first months of the COVID-19 pandemic, including: their ability and tendency to follow social distancing recommendations; attitudes toward regulations; and the economic and personal impacts of the pandemic. It provides unique insights into how these factors varied across the populations and neighborhoods of a single city—something not currently available from any other source, in Boston or otherwise. The survey was conducted over the summer as a collaboration of the Boston Area Research Initiative (BARI) at Northeastern University, the Center for Survey Research (CSR) at University of Massachusetts Boston, and the Boston Public Health Commission (BPHC). It was funded by the National Science Foundation's Human-Environment and Geographical Sciences (HEGS) program through a grant for rapid-response research (RAPID). The survey used a probability-based random sample stratified by 25 neighborhoods and the results presented here were weighted to match the demographic composition of the city as a whole. More detail on the survey methodology can be found in Appendix A.

This is the second in a series of reports describing key insights from the survey. The series focuses especially on the racial and socioeconomic inequities that have exacerbated—and may continue to exacerbate—differential impacts of the pandemic and the associated shutdown. In doing so, we consider four crucial classes of factors. The first class is personal characteristics, including race, ethnicity, socioeconomic status, pre-existing health, family structure (e.g., number of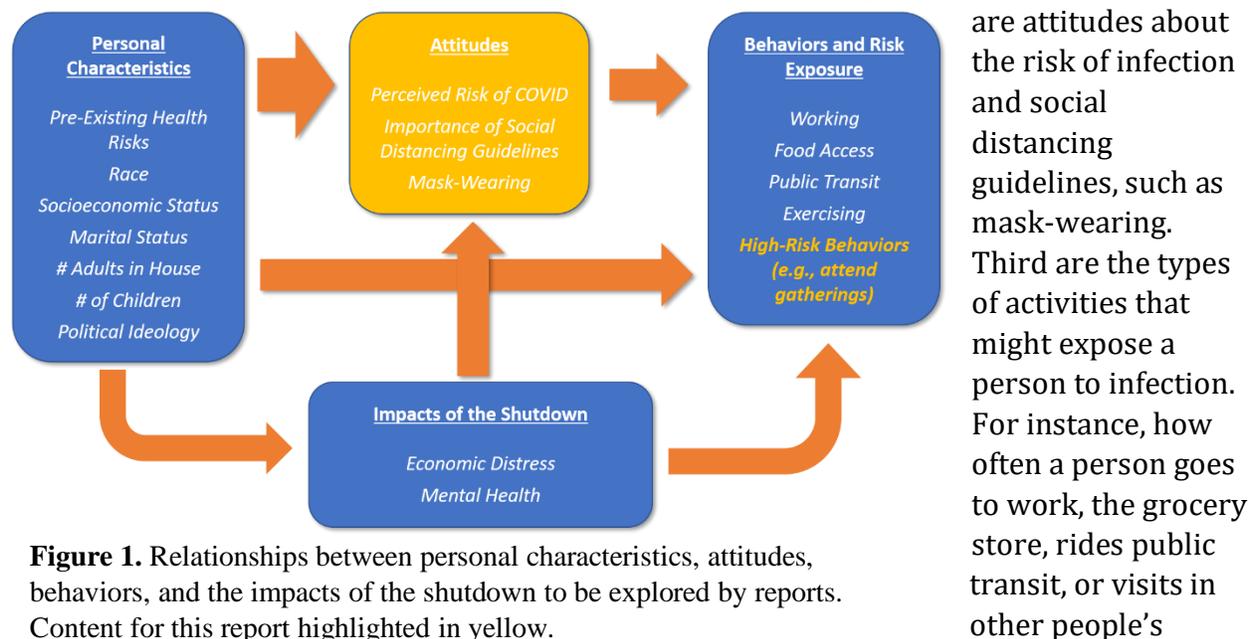 children), and political ideology. Second are attitudes about the risk of infection and social distancing guidelines, such as mask-wearing. Third are the types of activities that might expose a person to infection. For instance, how often a person goes to work, the grocery store, rides public transit, or visits in other people's

Figure 1. Relationships between personal characteristics, attitudes, behaviors, and the impacts of the shutdown to be explored by reports. Content for this report highlighted in yellow.

houses influences their exposure risk. Fourth, the survey included items on the impacts of the pandemic: employment, economic insecurity, and mental health.

We have designed the series to walk through the relationship between these features, as illustrated in Figure 1. Our first report described inequities in how Bostonians of different racial and socioeconomic backgrounds engaged in necessary day-to-day activities in April and the Summer. This second report examines how attitudes and beliefs regarding risk are distributed across the city—including their manifestation in mask-wearing and participation in discretionary, high-risk behaviors—revealing how minority populations are most concerned about the toll of the virus. Future reports will continue with analyses of: how an individual's personal characteristics predict attitudes and perceptions; how those personal characteristics *plus* attitudes and perceptions predict the kinds of activities people have engaged in during the pandemic; economic and mental health impacts across communities, and how they relate to behaviors and attitudes across individuals; and how these results relate to the content of other data sets, such as mobility patterns, administrative records, and social media activity, collected as part of this project.[1]

2. Most People Are Doing the Right Thing, But…

The survey asked respondents a range of questions about experiences, attitudes, and behaviors during the pandemic. In this report we focus on attitudes toward risk and social distancing guidelines and how they manifest in the form of mask-wearing and discretionary high-risk behaviors (see Table 1). [2]

- **Perceived Risk:** How much of a risk respondents felt that certain behaviors posed to their health, including being close to others outside of their home and attending gatherings.
- **Importance of Guidelines:** How important the respondent felt it was for them and others in their neighborhood to comply with social distancing suggestions and regulations, like staying home as much as possible.
- **High-Risk Behaviors:** The frequency of 4 discretionary activities, including in-house visits and attending gatherings. These were reported for the average week in April and for the previous 7 days (in the Summer).

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[1] https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/TDKDJJ

[2] Perceived risk and guideline importance featured strong internal consistency according to Cronbach's alpha (α = .80 and α = .81, respectively). Though the alpha for high-risk behaviors was somewhat lower (α = .65 in April and .54 in Summer), we maintained the scale owing to conceptual similarity between the items.

- **Mask-wearing:** Separate items regarding how often the respondent wore a mask when leaving the home in April and the Summer and what proportion of their neighbors wore masks in public in April.
- **Asymptomatic Spread:** Does the respondent believe that COVID-19 can be spread by people not showing symptoms.

An initial glance at the survey responses is heartening (see Figure 2 for full details): people largely reported wearing masks, avoiding risky activities, and endorsing guidelines. Nearly 75% of people said they always wore a mask in April, and this rose to 85% in the Summer. Similarly, 69% of people said they never went into another person's house or had a person visit in theirs during April (though this decreased in the Summer, as we will see). Meanwhile, the vast majority of people saw "moderate" or "large" risk in gatherings and

Perceived Risk of Infection: How much of a risk to your health and well-being is/are…
…Gatherings with friends that you do not live with?
…It to be close to people outside your home?
…It to be within 6 feet of people in public?
Importance of Guidelines: How important is it for people in your neighborhood to…
…Avoid gatherings with friends that you do not live with?
…Wear a mask or face covering when coming close to people outside the home?
…Stay at least 6 feet apart from other people in public?
…Stay at home as much as possible?
High-Risk Behaviors: In a typical week in April / In the last 7 days, how many days did you…
…Go out to eat at a restaurant, bar, or club?
…Visit inside some else's home?
…Attend any kind of event where more than 10 people were gathered
..Have people who do not live with you in your home, either to work or vist?
Mask-Wearing
In a typical week in April / the last seven days, when you left your home, how often did you wear a face mask or covering?
In April, how many of the people in your neighborhood did you see wearing a mask or face covering when they were out?
Asymptomatic Spread
In your opinion, can people who have no symptoms of COVID-19 give it to others?

Table 1. Survey items measuring attitudes and behaviors pertaining to risk, by category.

being close to people outside their house and saw it as "very" or "extremely" important that everyone in their neighborhood follow the guidelines imposed by the state. And 84% of respondents stated that those who are "infected" by the virus but not showing any symptoms of sickness (i.e., asymptomatic individuals) could transmit the disease to others, agreeing with the established science.

There are a few caveats to this idealized interpretation, however. First, the avoidance of high-risk behaviors and cautious attitudes toward risk were widespread but not universal. Just as in the national conversation surrounding the pandemic, some survey
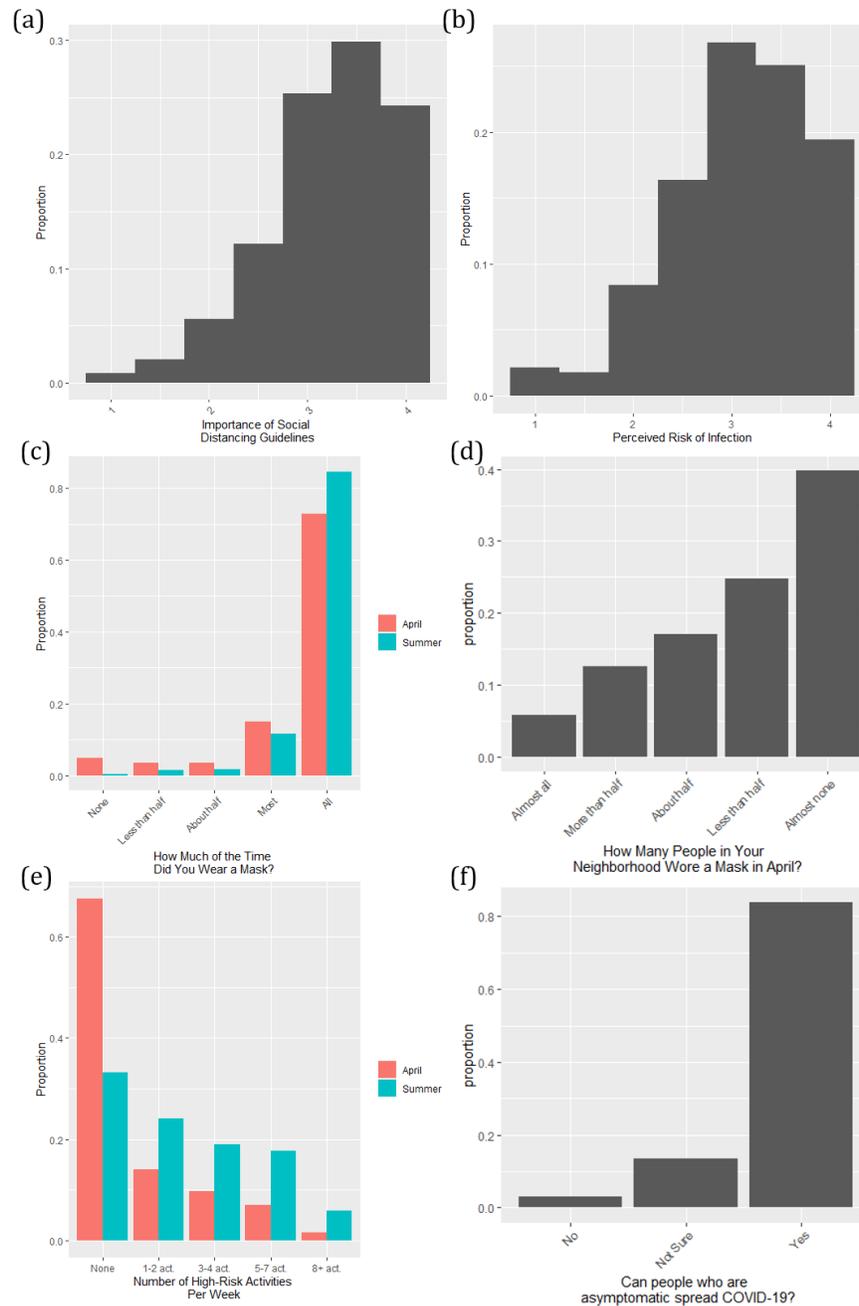
Figure 2. Distributions of (a) attitudes toward social distancing guidelines, (b) perceived risk of infection, (c) frequency of wearing a mask in April and Summer, (d) proportion of neighbors wearing masks in April, (e) number of high-risk activities per week, and (f) belief in asymptomatic spread. Note: importance of social distancing guidelines and perceived risk were measured on 4-point scales, with 4 = to greatest importance / perceived risk.

respondents were not always wearing masks, were engaging in risky behaviors, did not perceive such behaviors as risky, and did not endorse guidelines. Importantly, these were not always the same people. For instance, 44% of respondents said they always wore masks but had visited in other people's homes multiple times in the last week in the Summer. Also, it is intriguing to note that while most people claimed that *they* always wore a mask in April, only 40% said that "almost all" people in their neighborhood did. Last, the 16% of people that indicated that they were "not sure" or did not believe that transmission by asymptomatic individuals was possible were of course a minority, but certainly a non-trivial proportion of the population.

Second, there were some shifts in behavior between April and the Summer. We have already noted that mask-wearing increased, likely because of Gov. Baker's mask mandate on May 6th. But risky behaviors also went up. This was expected being that the severity of the pandemic had subsided over that time and society had partially reopened. For example, the proportion of respondents who visited in someone else's home in the previous week or had someone else visit in theirs increased from 31% in April to 55% in the Summer. Additionally, 19% of people said they had attended a gathering of 10 or more people in the last seven days in the Summer and 35% had visited a restaurant, bar, or club, compared to 4% of respondents participating in each activity in April.

In sum, most people were concerned about infection risk, endorsed social distancing guidelines, were wearing masks, and were avoiding high-risk discretionary activities. But there are those whose attitudes and behaviors were more ambivalent, thereby exposing themselves and their communities to greater risk. To better understand these implications we proceed by examining their distribution by neighborhood, race, and socioeconomic status.

3. Attitudes toward Risk and Guidelines: Signs of Ambivalence

Throughout the pandemic, there have been tensions, both locally and nationally, regarding the risk associated with the virus and the need for certain precautions, like maintaining personal distance and wearing masks. Unsurprisingly, we see substantial differences in these attitudes across neighborhoods and populations in our survey. These differences appear to track somewhat with questions of equity, but in the sense that residents of communities of color more strongly expressed concerns about infection exposure and endorsed the importance of social distancing guidelines than their White counterparts.
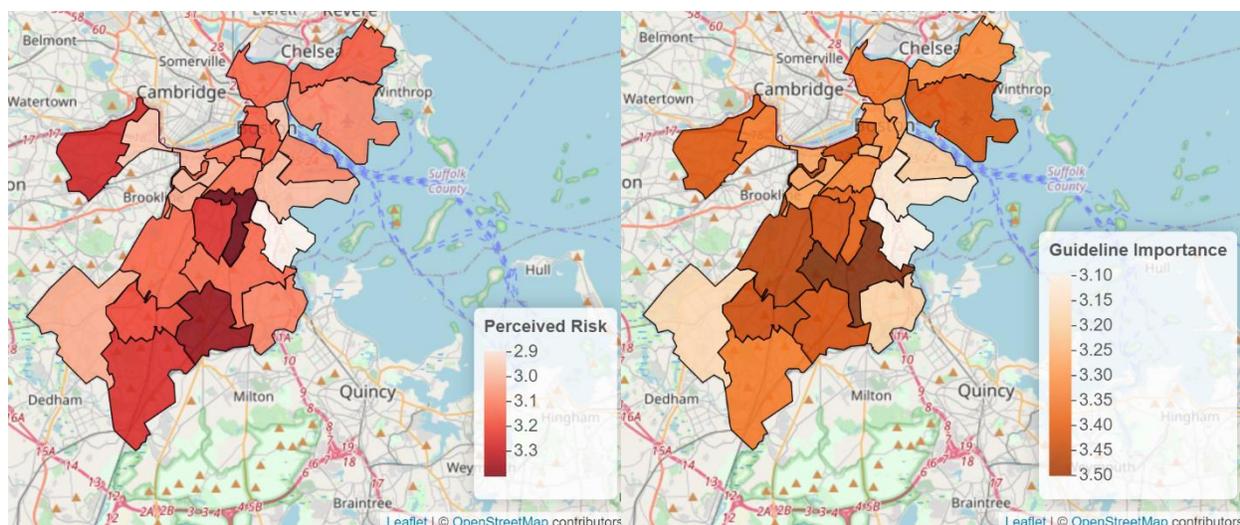
Figure 3. Differences across neighborhoods in perceived risk of infection (left panel) and the importance of social distancing guidelines (right panel). Both measures are on a 4-point scale, with 4 equal to highest perceived risk / importance of guidelines.

We see some clear geographic patterns in the distribution of perceptions of risk and attitudes toward social distancing guidelines (see Figure 3). Respondents from neighborhoods along Boston's east coast—South Boston and the Seaport, North End, and North and South Dorchester—tended to perceive lower risk and to rate the guidelines as less important. Meanwhile, respondents in the majority-minority southern urban core and the southern half of East Boston (i.e., Maverick Square, Jeffries Point) generally reported the highest perception of risk and most strongly endorsed social distancing guidelines. This aligns with the higher infection rates in these neighborhoods[3], as well as the findings in the first report in this series[4] that residents of these communities were more often in positions that exposed them to more risk.

A third group of more affluent, Whiter neighborhoods stood out from these other two groups as they did express lower levels of perception of risk but strongly endorsed social distancing guidelines. These included Jamaica Plain, Roslindale, Hyde Park, Back Bay, Beacon Hill, the southern half of East Boston, and Brighton. This might point to a belief that social distancing mechanisms are important but that those neighborhoods did not suffer from as high of infection rates nor the inequities that might have created a greater sense of risk.

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[3] https://www.bphc.org/whatwedo/infectious-diseases/Infectious-Diseases-A-to-Z/covid-19/Pages/default.aspx
[4] https://cssh.northeastern.edu/bari/wp-content/uploads/sites/30/2020/11/Report-1-Inequities-in-Navigating-a-Pandemic-1.pdf

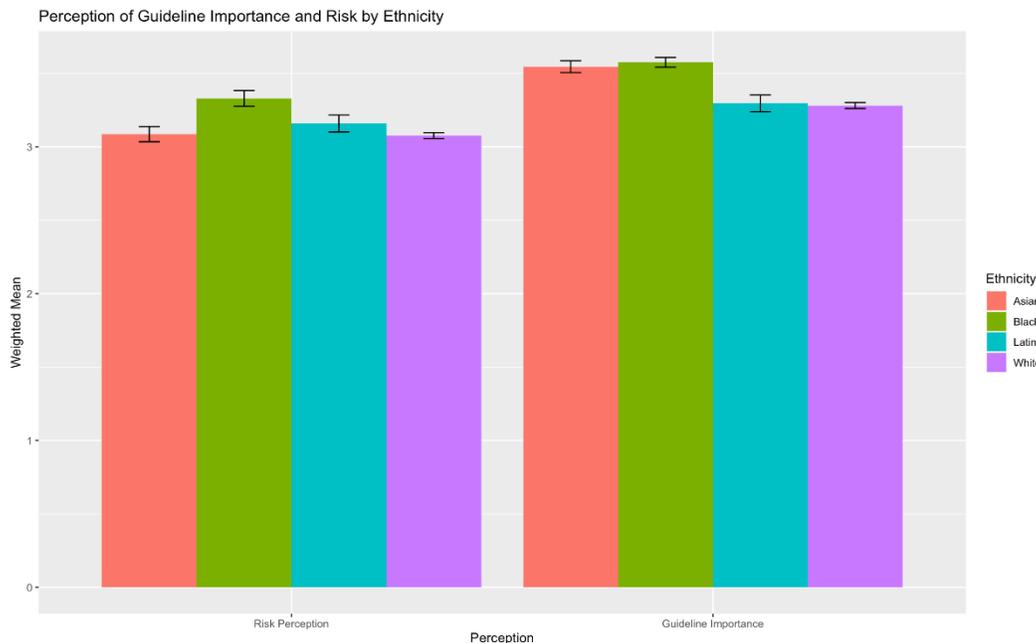Perception of Guideline Importance and Risk by Ethnicity

Figure 4. Differences by ethnic background in perceived risk of infection (left panel) and the importance of social distancing guidelines (right panel). Note: Bars represent 95% standard errors.

As we translate these geographic differences to demographics, it is unsurprising to see in Figure 4 that White respondents on average had the lowest concern about risk and saw the least value in social distancing guidelines. It is important to note, however, that because most scores on each scale were quite high, this reflects greater variation in attitudes across White respondents. Two other features stand out as well. First, Black respondents on average expressed the strongest concerns regarding risk of infection and endorsements of guidelines, joined in the latter by Asian respondents. Meanwhile, Latinx respondents were closer to their White counterparts in their attitudes toward social distancing guidelines.

4. High-Risk Behaviors: Acute Neighborhood Differences

Certain forms of socialization have been highlighted as the riskiest for infection exposure: visiting in other people's homes, attending gatherings of 10 or more people, and frequenting restaurants and bars. Focusing on Summer—which is when society began to "reopen" and such behaviors started to become more feasible, if not always recommended—we see substantial differences in these behaviors across neighborhoods

and populations. These differences largely mirrored the distribution of attitudes toward risk and guidelines described in the previous section (see Figure 5).

We see discretionary high-risk behavior most heavily concentrated in respondents from the same eastern neighborhoods that tended to report lower perceptions of risk and that the guidelines were less important—South Boston and the Seaport, North End, and North Dorchester. Interestingly, some of these neighborhoods are known for their amenities, including restaurants, bars, and beaches, that were reported over the summer as attracting large gatherings. It is not clear, though, if those visiting these locations were residents are individuals from other neighborhoods or municipalities.

When we transition to racial and socioeconomic variations, we see that White respondents were somewhat more likely to participate in high-risk activities—72% of respondents said they engaged in at least one such activity in the previous week, whereas the same proportion was only around 60% of Black and Latinx respondents and 55% of Asian respondents (see Figure 6). This same pattern is repeated when we compare high-income respondents to lower-income respondents, with the former engaging in more risky behavior. It is possible that this is explained by lower infection rates—and thus lower concern—among these populations.
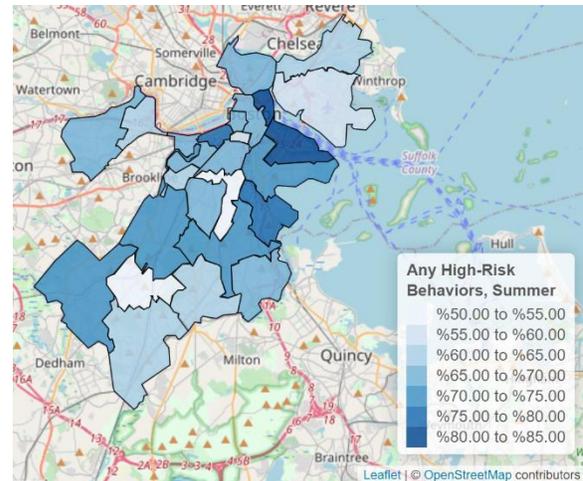

Figure 5. Percentage of individuals engaging in at least one high-risk activity per week in Summer, by neighborhood.
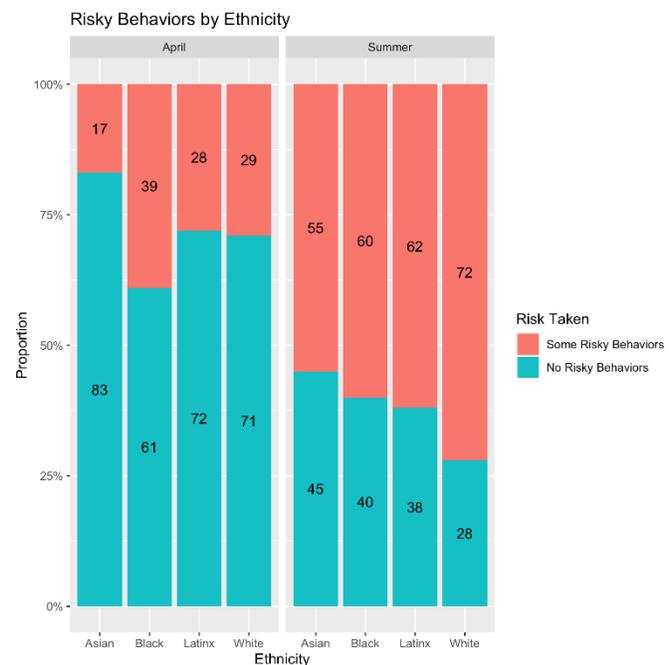

Figure 6. Proportions of individuals participating in at least one high-risk activity per week in April (left panel) and Summer (right panel), by race.

5. Mask Wearing: Self and Others

Wearing masks has been noted as one of the simplest and most effective tools for curtailing the spread of COVID-19. As noted, we see that respondents overwhelmingly adopted this custom. There are two caveats, however. First, there is a difference between "overwhelming" and "universal" adoption, and there are certainly respondents who reported not always wearing masks in public, and even a few who said they never wore masks. Second, when asked whether people in their neighborhood were wearing masks in April, the reports were less positive. Only 40% of respondents said that all of their neighbors did so.

Looking first geographically, respondents from the southern urban core, especially parts of Roxbury and Central Dorchester (e.g., Codman Square, Franklin Field), were most likely to report wearing masks themselves and that their neighbors did the same—except for central Roxbury (e.g., Dudley Square), where respondents reported low levels of mask wearing by neighbors. East Boston also tended to have higher levels of mask wearing on both measures.

On the other end of the spectrum, the eastern neighborhoods that had the highest risk behaviors, lowest perception of risk, and lowest endorsement of social distancing guidelines were also low on reported mask wearing. This was especially true when respondents described their neighbors. Meanwhile, most other neighborhoods fell
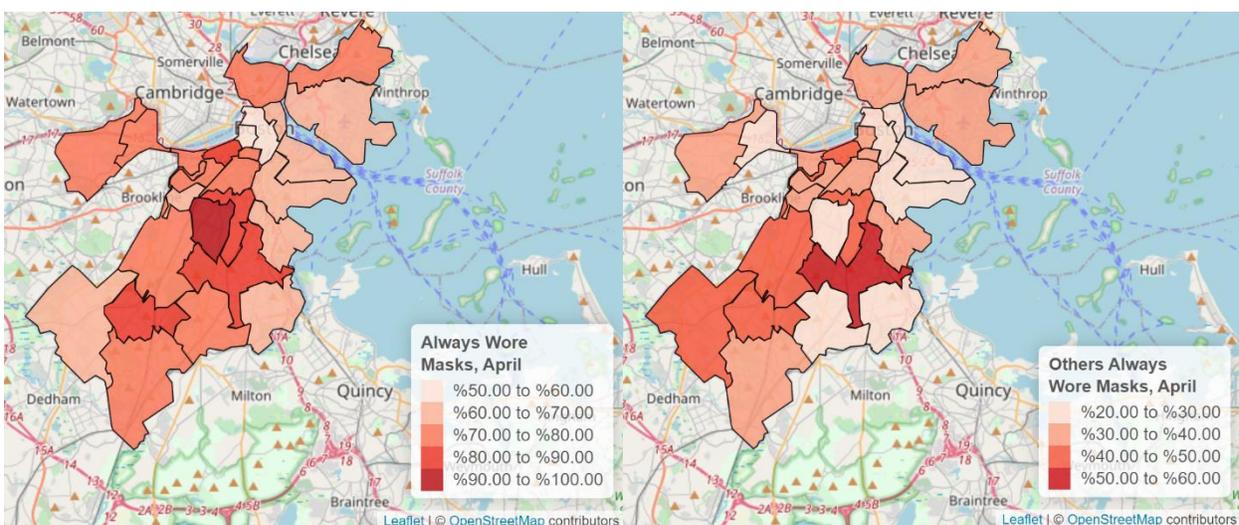

Figure 7. Proportion of people who said that they always wore a mask in public (right panel) and said that their neighbors all wore masks in public (left panel) in April, by neighborhood.

somewhere in between, as they did for attitudes and high-risk behaviors. The potential explanations for this are varied. It could be a function of perceptions of risk and attitudes toward guidelines in these communities, or there may be other local dynamics. For example, those living in neighborhoods like Jamaica Plain or West Roxbury may have more space in their neighborhoods where they feel comfortable taking a walk without a mask because they can maintain safe social distance, which is not necessarily the case in the more densely populated areas of the city. This would also be consistent with the finding in our previous report[5] that people in the less dense neighborhoods spent more time exercising or walking outdoors.

      The distribution of mask wearing—either by oneself or by others—appears to be better understood geographically than demographically. We did see modest differences across races (see Figure 8), particularly with fewer White respondents indicating that they and their neighbors wore masks all the time. We also see a similar tendency among higher income residents. But these trends on their own are not easily interpretable and will need to be examined more thoroughly. In any case, it is important to keep in mind that even a
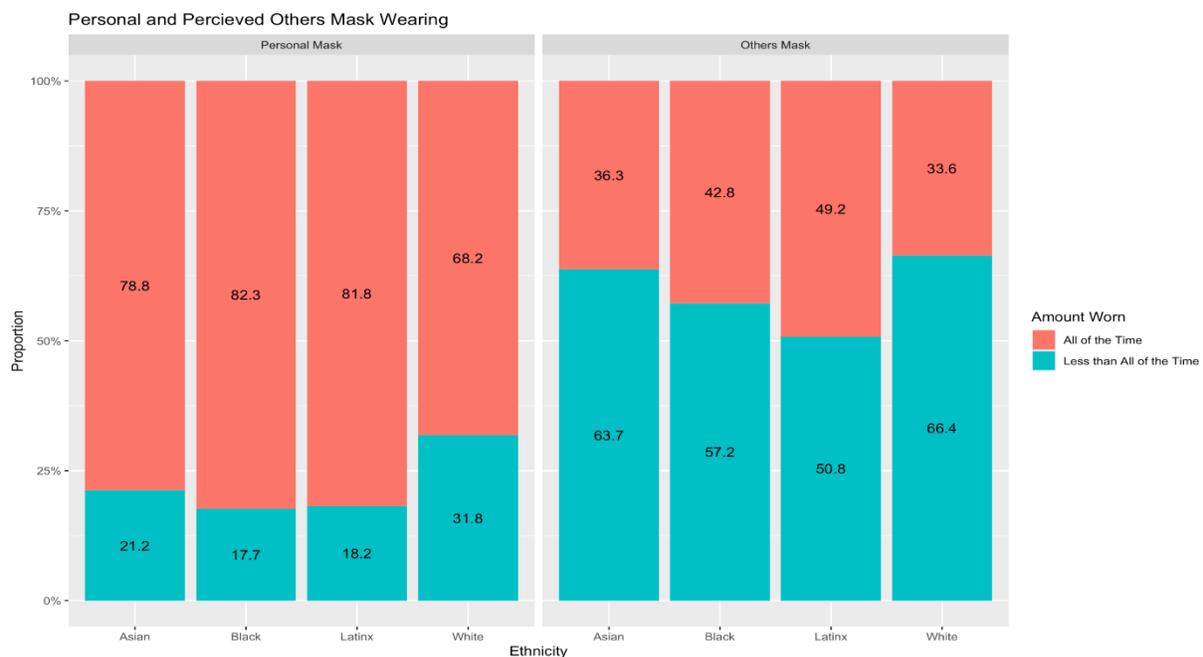

Figure 8. Proportion of individuals saying that (a) they always wearing masks and that (b) their neighbors always wore masks in April, by ethnicity.

[5] https://cssh.northeastern.edu/bari/wp-content/uploads/sites/30/2020/11/Report-1-Inequities-in-Navigating-a-Pandemic-1.pdf

small number of individuals choosing not to wear masks can have a broader impact on transmission in a community.

6. Asymptomatic Spread: Fact or Fiction?

One of the most challenging parts of both understanding and managing COVID-19 is the ability of asymptomatic individuals (i.e., those who are "infected" by the virus but not showing any symptoms of sickness) to transmit the disease. The survey asked whether, in the respondent's opinion, this was the case. Again, 85% of respondents believed that asymptomatic spread of the disease was possible, showing strong agreement with the established science. That means, however, that 15% of people indicated that they were "not sure" or did not believe that transmission by asymptomatic individuals was possible. This might be the minority, but it is still concerning. 15% is a non-trivial proportion of individuals

Figure 9. Percentage of individuals who did not believe that asymptomatic individuals could spread COVID-19, by neighborhood.

whose calculation of risk and personal choices might be predicated on this misunderstanding, and this very well might be even more common in certain communities.
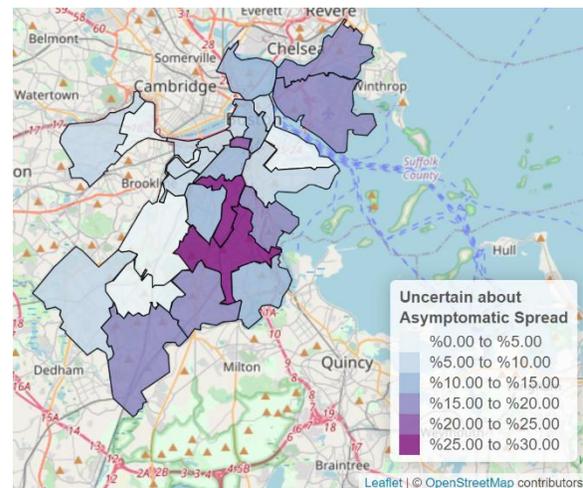
The geographic distribution of beliefs about asymptomatic spread mapped closely to socioeconomic status (see Figure 9). We see that in affluent western neighborhoods like Roslindale, Jamaica Plain, West Roxbury, and Allston and Brighton, nearly all respondents agreed that asymptomatic spread was possible. Meanwhile, less affluent southern neighborhoods like Hyde Park, Mattapan, and South Dorchester had the greatest number of respondents who felt differently.

These geographic differences manifested in marked demographic differences. Racially, we see that among Black and Latinx respondents approximately 25% and 35%, respectively, did not fully believe that asymptomatic spread was possible (though not visualized here). Similarly, looking across the economic spectrum (see Figure 10), over 25% of respondents making <$30,000 annually felt this way while *almost every respondent* making more than $75,000 per year believed that asymptomatic spread was possible.
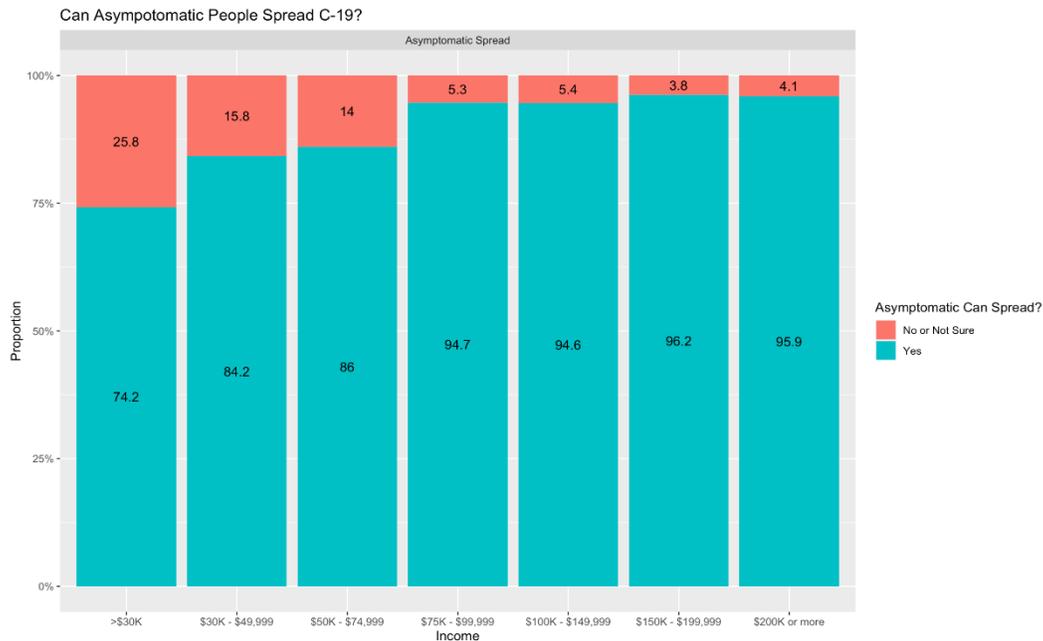
Figure 10. Proportion of individuals who did not believe that asymptomatic individuals could spread COVID-19, by income level.

7. Conclusion

On the surface, there was broad agreement in attitudes towards the pandemic and mitigation efforts. Most people saw certain behaviors as risky, believed that social distancing guidelines were important, wore masks, and refrained from high-risk behaviors. Not everyone felt and behaved the same way, however. A substantial proportion of people differed from these attitudes and expectations. Such individuals were more likely to be White and higher-income, possibly reflecting an ambivalence among those who felt less threatened or affected by COVID-19. One exception to this pattern was in beliefs about asymptomatic spread of the disease. Lower-income respondents—and, in turn, Black and Latinx respondents—were less likely to state that they believed that asymptomatic individuals could spread the disease.

Practically speaking, these results expose ways in which each community might be vulnerable to spread as cases surge again. On the one end of the economic spectrum, we see some ambivalence toward guidelines themselves. On the other we see more misunderstandings about how the virus can be spread. As with our previous report on inequities in necessary activities, this suggests different types of messaging campaigns to support and educate each of these communities in the coming months.

Appendix A. NSF Beacon Survey Methodology

The NSF-Beacon survey is a collaboration of the Boston Area Research Initiative (BARI) at Northeastern University, the Center for Survey Research (CSR) at University of Massachusetts Boston, and the Boston Public Health Commission (BPHC), funded by the National Science Foundation's Human-Environment and Geographical Sciences (HEGS) program through a grant for rapid-response research (RAPID) for collecting ephemeral data during or following a crisis. The survey captures the experiences of 1370 Bostonians during the first months of the COVID-19 pandemic, including ability and tendency to follow social distancing recommendations, attitudes towards regulations, and economic and personal impacts of the pandemic. The design allows for a unique observation of neighborhood-level estimates for these factors.

I. Sample Design and Final Sample

The NSF-Beacon survey used a stratified random sample that divided the city of Boston into 25 distinct neighborhoods. The neighborhoods were defined in collaboration with members of the Mayor's Office and other experts based on social, demographic, and historical salience. They were constructed to conform to census block group boundaries, meaning that metrics associated with census geographies (including from the U.S. Census Bureau) could be linked with the data. The Marketing Systems Group (MSG) was contracted to draw a simple random sample of residential addresses from within each neighborhood. They used the most recent United States Postal Service Computerized Delivery Sequence File (CDSF) to draw Address-Based Samples (ABS) of residential addresses. Four neighborhoods with a higher proportion of Black or Latinx populations were oversampled (Hyde Park, Mattapan, Lower Roxbury, and East Boston-Eagle Hill). As shown in Table 1, there were unbalanced sample sizes and selection probabilities across neighborhoods, meaning analysis of the data requires survey weights to correct for these differences. In addition to the survey being administered to the sample obtained for the NSF-Beacon study, we also invited participants in the previously-constructed Beacon panel, which had been recruited using the same 25 neighborhood stratified sample design.

II. Data Collection Methodology

Paper copies of the survey, plus instructions for completing and returning, and a $2 cash incentive were mailed to all sampled addresses. For three neighborhoods known to have higher percentages of Hispanic households, the materials mailed, including the survey instrument, were in both English and Spanish. All recipients were also given the option of completing the survey online and an associated URL. A randomly assigned half of the mailed questionnaires had instructions for the oldest adult 18+ in the household to complete the survey while the other random half had instructions for the youngest adult 18+ to complete the survey. In this manner,

an attempt was made to randomize the age of the respondent within the household completing the survey. Approximately two weeks after the initial mailing of materials, a second mailing was sent to nonrespondents, though with no additional incentive.

Table 1. NSF-Survey neighborhood sampling specifications

Neighborhood	# of Sampled Addresses	Prob. of Selection	# of Completed Surveys	Response Rate[1]
Allston	192	0.01702	51	28.81%
Back Bay	194	0.01871	53	31.36
Beacon Hill	204	0.03593	53	30.11
Brighton	187	0.00839	58	31.87
Central	198	0.06119	50	27.78
Central Northeast	196	0.02839	58	33.14
Central West	200	0.01665	55	32.35
Charlestown	190	0.02286	62	34.25
Dorchester Central	189	0.01042	39	21.08
Dorchester North	188	0.02661	42	23.86
Dorchester South	191	0.01671	60	32.97
East Boston	189	0.02501	43	24.29
East Boston-Eagle Hill	355	0.04189	93	27.84
Fenway/Kenmore	195	0.01169	39	21.91
Hyde Park	364	0.02967	59	17.10
Jamaica Plain	188	0.01138	71	39.66
Jamaica Plain-Mission Hill	191	0.02737	55	30.73
Lower Roxbury	372	0.05977	57	17.59
Mattapan	362	0.02704	61	17.58
Roslindale	188	0.01820	73	40.11
Roxbury	188	0.01511	37	20.67
Seaport	192	0.04554	40	22.47
South Boston	191	0.01150	45	24.86
South End	188	0.01070	57	32.02
West Roxbury	189	0.01407	59	32.24
Total	**5481**		**1370**	**26.88%**

[1] Response rates computed using AAPOR Method 3.

III. Data Collection Results

The final sample included 1370 completed surveys (1208 paper, 162 online; 30 were completed in Spanish). The number of completed surveys ranged from 37 in Roxbury to 93 in East Boston-Eagle Hill. Overall response rate was 26.88% and ranged from a low of 17.10% in Hyde Park to a high of 40.11% in Roslindale. Full details on each neighborhood sample are presented in Table 1. An additional 256 completed surveys were obtained from members of the previously-constructed Beacon panel, bringing the total number of completed surveys to 1626.

IV. Weighting of survey data

The sample requires weighting to account for both differing probabilities of selection and response rates across neighborhoods, especially insofar as these differences create a sample that is demographically and geographically non-representative. We created two survey weights, one for sample design factors including probability of selection and number of adults in the household adjusted for nonresponse bias across neighborhoods, the other which adds a post-stratified weight to account for demographic non-representativeness. Additionally, we conducted this process twice. First, we did it only for respondents to the NSF-Beacon survey. Second, we replicated the procedures for the dataset that combined the NSF-Beacon survey responses with respondents from the previously-constructed Beacon panel (values reported in Table 2 for weighting are highly similar for the NSF-Beacon responses alone and the merged data set).

Weights for Nonresponse Bias
Weighting for nonresponse began by neighborhood with the inverse of the probabilities of selection adjusted for the response rates displayed by neighborhood according to the equation (see Table 1 for values):

W_b = (Inverse of probability of selection) / (neighborhood response rate)

The final nonresponse adjusted weight further multiplies the base weight by the number of adults 18+ in the household (capped at 4 to prevent excessively large weights). Finally, these weights are adjusted so that the percentage of the total 18+ population in Boston that belongs in each neighborhood agreed with control percentages computed from the 2014-2018 5-year American Community Survey (ACS) data from the Census Bureau. These weights sum to the ACS estimate of the total 18+ population in the city of Boston. Therefore, the final nonresponse adjusted weight can be defined as:

W_{NR} = (W_b)(number of adults in household)(ACS population adjustment factor)

Post-Stratified Weights

As shown in Table 2, even after nonresponse weights, the respondents to the survey were not demographically representative of Boston's population. Most notably, people with education beyond 4-year college degrees were overrepresented and those with a high school education or less were underrepresented. Women were also overrepresented relative to men and White non-Hispanics were overrepresented relative to Blacks and Hispanics. There was also a smaller age bias with too many 65+ people and too few 18-34. A final adjustment to the survey weights was implemented to adjust for differential survey nonresponse by age, gender, race/Hispanic origin, and education. Control percentages for these categories were computed from the 2014-2018 5-year ACS data. Post-stratification factors were then computed to match weighted survey data to citywide percentages. The final post-stratified weight can be expressed as:

$W_{PS} = (W_{NR})$(post-stratified factors)

It should be noted, though, that a small amount of trimming of weights, less than one percent of all sample cases, was employed to prevent some extreme values in the post-stratified weights. As shown in Table 2, this additional adjustment process brought the weighted survey estimates much more in line with ACS citywide estimates.

Table 2. Comparison of ACS controls to nonresponse and post-stratified weights

	ACS	Nonresponse	Post-stratified
Age			
18-34	46.90%	38.40%	46.20%
35-49	21.3	20.1	21.5
50-64	18.4	22.1	18.6
65+	13.4	19.4	13.7
Gender			
Male	47.60%	38.00%	47.60%
Female	52.4	62	52.4
Education			
High School including GED or less	33.60%	16.40%	32.50%
Some college including 2-year degree	17.8	14.8	18
4-year college degree	26.5	29.3	27
Beyond 4-year college degree	22.1	39.5	22.5
Race/Hispanic origin			
White non-Hispanic	49.40%	57.50%	49.40%
Black non-Hispanic	20.6	15.8	20.6
Hispanic	16.9	12.4	16.9
Other	13.1	14.3	13.1