FEMINIST STREETSCAPES

A Study on Perceptions of Streetscapes in Eugene, Oregon

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ABSTRACT

In the United States, women often perceive traveling to be an inconvenient and uncomfortable experience. This experience is the result of the disproportionate role men have historically played in transportation system design. By not considering the travel needs and preferences of women, systems were designed that neglected the everyday transportation habits of half the population. This issue has broad implications because our streets make up most of our urban public space, yet their convenience to all users is often not considered when being designed (Toomey 2012). The primary objective of this research was to determine whether and how perceptions of streetscapes vary by gender, age, or familiarity with place. This project also aimed to identify typologies of positive and negative street design elements that contribute to pedestrian level of comfort. A literature review, visual preference survey, and precedent studies were used to complete this research. The findings from these methods guided typology generation, and the findings from the typology generation informed three design solutions. An online visual preference survey with 408 participants found that there is no substantial difference in perception by gender or familiarity of place, yet perception varies slightly by age cohort. Women can be considered a keystone species. If women perceive the streetscape just as positively as men do, then that streetscape is well-designed for all and is accessible for vulnerable populations. In addition, regardless of gender, age, or familiarity, most respondents positively perceived streets with well-defined, protected walkways. Future research will be needed to further examine if other variables such as race, noise, or time of day affect perceptions of streetscapes.

ACKNOWLEDGEMENTS

Roxi, thank you for listening to my wild idea last year and helping me turn it into a meaningful research project. Thank you for sharing my survey and helping me smash my response goal tenfold. Thank you for meeting with me each week and reassuring me each time that I was doing fine, and that everything was going to be fine.

RJ, thank you for testing my survey as many times as you did. Thank you for reading my report before every submission. Thank you for listening to me and giving me feedback with no notice. Thank you for supporting me through this project and through my whole time working towards my degree.

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For the record, I cried the entire time writing this page. You all have made massive impacts on me these last three years. The pleasure has truly been mine.

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CHAPTER 1: Introduction

1.1 Scope

This project analyzes visual perception of street safety in Eugene, Oregon with a focus on understanding the unique perceptions of women in order to provide recommendation to improve comfort and increase pedestrian use of streets. This project has two components. The first component is an online visual preference survey to identify differences in perception, as well as positive and negative aspects of Eugene's streetscapes. The second uses the survey along with precedents to develop a design toolkit. The primary objectives of this project are to determine if perception of comfort varies by gender, and to identify a typology of uncomfortable street design elements in the landscape, and propose their respective design improvements. This project will also emphasize the need to acknowledge female travel perceptions when designing and planning city's streets.

1.2 Significance

People typically spend eight to ten times more time on streets than they do in parks, yet landscape architecture focuses heavily on park design and steers away from street design (Toomey 2012). Consequently, streets are poorly designed in general, with particular impacts on vulnerable populations, including women, who represent half of the population (Friedman n.d.). If designers and policy makers helped create safer, more walkable streets it would increase active transportation, decrease car dependency, and work towards mitigating the effects of climate change. This challenge is particularly significant in urban areas, where more than half of the world's population lives, because they account for more than 70 percent of global carbon emissions (Glazebrook and Newman 2018). The transportation sector was the largest source of carbon emissions in the United States in both 2017 and 2018 (Irfan 2018). Furthermore, studies show that designing streets for people rather than cars also increases economic productivity, produces a higher tax value per acre, and offers a better return on infrastructure investment (Quednau 2018a). This project is aimed at designers and policy makers who can use its findings to design more inclusive streetscapes.

1.3 Research Questions

This project addresses four research questions:

- Do street design preferences vary by gender?
- Do street design preferences vary by age group?
- What street design elements are perceived as negative?
- What street design elements improve perceptions?

CHAPTER 2: Literature Review

In the United States, women often perceive traveling to be an inconvenient and inaccessible experience. This experience is the result of the disproportionate role men have historically played in transportation system design. By not considering the travel needs of women, systems were designed that neglected the everyday transportation habits of half the population. There are several noticeable examples of this, like car headrests that do not accommodate ponytails, but a less obvious example is the streetscape, which is the appearance or view of a street. This issue has broad implications because our streets make up most of our urban public space, yet their appearance to all users is often not considered when being designed (Toomey 2012). Moreover, gender-inclusive street design also supports other community goals, such as promoting sustainability and economic vitality. With half the population identifying as female, understanding how all genders perceive its transportation system can help the community achieve a better design for all.

There are several key benefits associated with walkable streets. First, they are considered more attractive, safe, and help businesses thrive (Quednau 2018b). Human-scale streets are safer for everyone because they require everyone to slow down and pay more attention to their surroundings (Quednau 2018b). Walkable streets also provide benefits geared specifically towards women. Women are more physically active and healthy in walkable places; if cities are built to allow women to walk safely, they will use active travel and overall health will improve (Matchett n.d.). Understanding the current safety concerns of streets is crucial to understanding how streets can be improved through design. Although women walk and use transit more than men, increasing female comfort on streets would increase their likelihood to walk. That increase would come with benefits at a variety of scales, from individual health benefits to urban economy to climate change mitigation.

2.1 Gender and Travel Patterns

Literature on female travel patterns has become increasingly more available. Studies show that a typical trip made by a man looks very different from a typical trip made by a woman. Women make more daily trips but travel fewer miles, are more likely to make trips to serve others, such as children, and are more likely to chain trips together than just one destination and then back home (Conference on Research on Women's Issues in Transportation 2006). This makes women's travel patterns much more complex than men's typical twice-daily commute in and out of town (Criado-Perez 2019). In fact, adult women are more likely than men to have multiple destinations in one trip or take several trips per day, shown in Figure 2.1 on page 5. (McGuckin and Murakami 1999). As a result, many of the trips that women commonly make are ideally suited for walking (Matchett n.d.).

While many countries lack consistent, sex-disaggregated data, studies of existing data found that women are more likely to walk and take public transport than men (Criado-Perez 2019). This is likely a result of more men having a driver's license and owning a car than women (Beirão and Cabral 2008). Women are more likely to use public transportation for non-work trips, where men are more likely to use a car for both work and non-work trips (Beirão and Cabral 2008).

Travel patterns also differ by household gender role. Men tend to travel alone, while women are more likely to travel with children or elderly relatives they are caring for (Criado-Perez 2019). When with children, women are more likely to drive because they have control over how safe the children are and feel (Matchett n.d.). Women also tend to make more complex chained trips when with children than women travelling without children (McGuckin and Murakami 1999).

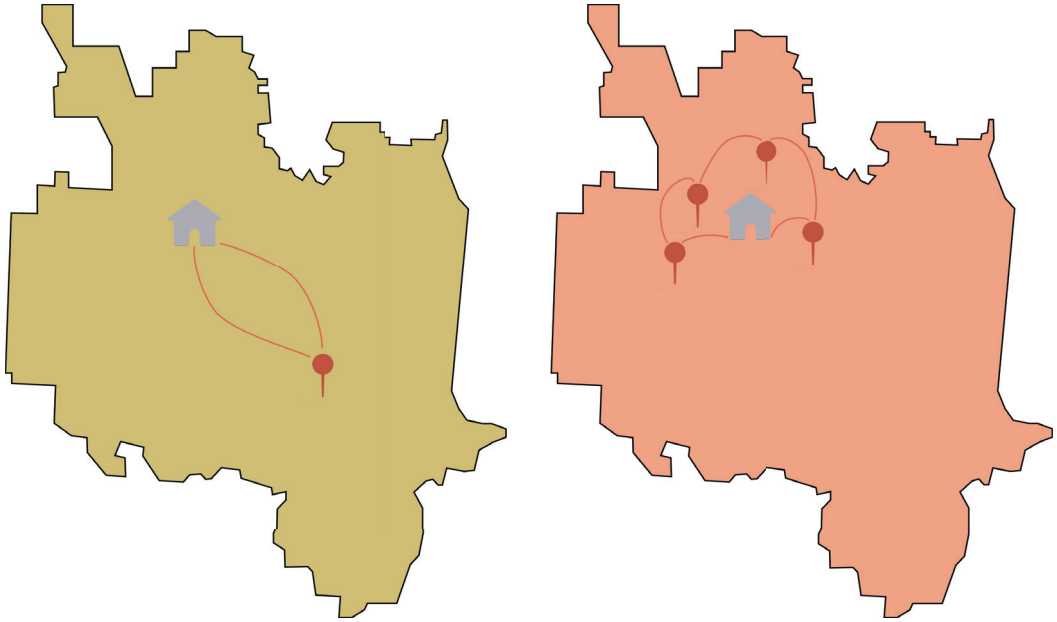


Figure 2.1: Male (left) and Female (right) Travel Patterns

2.2 Decrease Car Dependency

The first step toward making streets safer for pedestrians is switching the priority of the street away from cars. Car dependency can be reduced by design interventions at the neighborhood or street level. Studies show that a neighborhood concentrated with a larger population, more activities, streets, and pedestrian infrastructure result in reduced personal vehicle use (Jiang et al. 2017). In fact, enhanced street design can lead to a reduction of 12.3 percent vehicle miles travelled (VMT) (Jiang et al. 2017). Designing streets with all modes of transportation in mind increases accessibility and safety for active transportation like walking and cycling (Keippel et al. 2017). Walkable streets with continuous street facades and small setbacks were found to reduce VMT (Jiang et al. 2017). In contrast, poor street design, disparate land use, time constraints, and lack of personal safety all will force women off their feet and into cars (Matchett n.d.). Improving street design to enhance comfort would encourage people to use active transportation more and reduce car dependency.

2.3 Mitigate Effects of Climate Change

The streetscape is a natural place to look when trying to reduce greenhouse gas (GHG) emissions. With more than 50 percent of the world's population living in cities, urban areas account for over 70 percent of global CO2 emissions (Glazebrook and Newman 2018). The transportation sector was the biggest source of CO2 emissions in the U.S. for the second year in a row in 2018 (Irfan 2018). Transportation accounted for 28 percent of U.S. total GHG emissions in 2006 (Younger et al. 2008). Pedestrians and bicyclists have a much smaller effect on the environment (Gehl 2010). If walking rates increased by about eight percent globally, for instance, urban carbon emissions would drop by about 11 percent (Anzilotti 2018). Designing streets with a greater emphasis on pedestrians and cyclists can help facilitate the transition away from cars (Gehl 2010). Making streets more comfortable for women would also encourage more active transportation, get more people out of their cars, and contribute to mitigating the effects of climate change by reducing their individual carbon footprint.

2.4 Economic Boost

Streets designed for people over cars were found to not only be safer, but also more economically productive than any other style of development, leading businesses to thrive (Quednau 2018a). Walkable streets are less likely to have vacant storefronts, activating the street façade (Peters 2016). These types of streets encourage business activity, generate greater tax revenue per acre, and offer a higher return on investment than auto-oriented streets (Quednau 2018a). In Dublin, a redesigned pedestrian-friendly neighborhood led to a 300 percent increase in employment (Peters 2016). Transit users and walkers spend less at a business per trip, but make more trips in a given month, adding up to a higher spending total than those driving (Quednau 2018a). Overall, biking and walking provide about a $12 return on investment for every $1 spent on infrastructure (Peters 2016). Encouraging people to use active transportation in their neighborhoods directly improves social comfort and the local economy.

2.5 People in Public Spaces

Pioneers like Jane Jacobs, William H. Whyte, and Jan Gehl have encouraged designers and planners to observe how people use space in cities (Gehl and Svarre 2013). With different activities occurring in the same place, public spaces are constantly changing (Gehl and Svarre 2013). Only a small amount of space in a streetscape is leftover for pedestrians with most of the space on the roadway designated for the vehicle (Whyte 1984). If public space is improved to invite people, more people will use it (Gehl 2010). Cities should provide good conditions for walking, standing, sitting, listening, and talking, as these encourage people to spend more time in public space, thus increasing the safety potential (Gehl 2010). A city is only as interesting as its streets, and a used street is well suited to be a safe street (Jacobs 1961). If a walkway has walls on either side, it may feel narrower than it is, but if bordered by open space it may borrow that space and feel wider (Whyte 1984). If people fear streets, they will use them less, and in turn make the streets even less safe (Jacobs 1961). An uncrowded sidewalk is a sign of a dead downtown (Whyte 1984).

The Complete Streets movement aims to include the needs of all users on one street (Ma 2017). People-oriented streets are welcoming, safe, and accessible for all forms of transportation, but especially walking, with buildings, sidewalks, and other features all at human-scale (Quednau 2018b). Designing streets with all modes of transportation in mind increases accessibility and safety for active transportation like walking and cycling (Ma 2017). For a street to be designed at the human-scale, there should only be one narrow lane for each direction, with street parking or parking behind buildings, lots of windows and signage, and safe sidewalks and crossings (Quednau 2018b). For a city to invite people to walk, it must provide short walking distances, attractive public spaces, and a variety of urban function (Gehl 2010). Building the proper infrastructure will invite more people to use it, and more people around in public spaces leads to those spaces feeling safer and more comfortable.

2.6 The Gap in Knowledge

A sizeable body of research exists on how to design streets, the impacts street design has, and how people use streets and other public spaces. Yet how people's perceptions of streets impact their travel preferences has yet to be studied. My research builds upon the seminal work of urbanists like Jan Gehl and William "Holly" Whyte, who studied public spaces by observing what people do within them. Instead, this study examines the impact of streetscape design by showing people a street and asking how they perceive the space's features.

Methods

CHAPTER 3: Methods

This project began with a literature review to understand the current theories, practices, and critiques of streetscape design through the lens of gender. To better understand current weaknesses and potential improvements of streetscape design for women, a visual preference survey was developed and distributed. Upon closure of the survey, survey analysis and precedent studies occurred simultaneously to then inform the creation of a design typology. The typology generation phase then informed the design phase, the final phase of the project.

Figure 3.1: Methodology

3.1 Visual Preference Survey

An online visual preference survey was used to determine whether different populations had different perceptions of streetscapes, and what aspects of design led to positive or negative perceptions. The survey contained two elements: a Likert scale question of overall comfort of selected images, and a heat map to select elements using the same images. The data obtained from this survey was analyzed based on gender, familiarity with place, and age to determine whether those categories impacted perception of space. Findings from the survey were then used to identify the most and least comfortable images. These images were further visually analyzed to determine the landscape elements, or typologies, that contributed to the perception of the place.

The visual preference survey was distributed in three ways. The survey link and information were shared through the listserv of a University of Oregon student group focused on active transportation. The listserv includes students, faculty, alumni, and members of the Eugene/Springfield community. The survey link and information were also shared in two Facebook groups for alumnae of Wesley College, an all-female institution, with one focused on the general alumnae community and the other focused on academia. Additionally, the survey link and information were shared via the researcher's personal social media, including Facebook, Twitter, and LinkedIn. From these three distributions, the survey was freely shared further by participants.

The survey asked minimal demographic questions to encourage participation – asking only respondent's sex, age, and affiliation with the University of Oregon. The survey included 21 images, chosen to represent a variety of street design types. The first image question asked for a comfort scale rating, with 1 being very uncomfortable and 5 being very comfortable, shown in Figure 3.1. If the participant responded with 1 or 2, they proceeded to a heat map question where they were asked to identify anything in the picture that contributes to their discomfort, shown in Figure 3.3. The same heat map question was asked if the respondent answered 4 or 5, but asking about anything in the picture that made them feel more comfortable. They were then offered the opportunity to comment on the elements they clicked on if they would like. If the respondent answered with 3, which represents neutral, they skipped the heat map questions and moved to the next image.

Very uncomfortable 1 2 Neutral 3 4 Very comfortable 5

On a scale of 1 to 5, how comfortable would you feel being on this sidewalk?

Figure 3.2: Likert Scale Question Sample

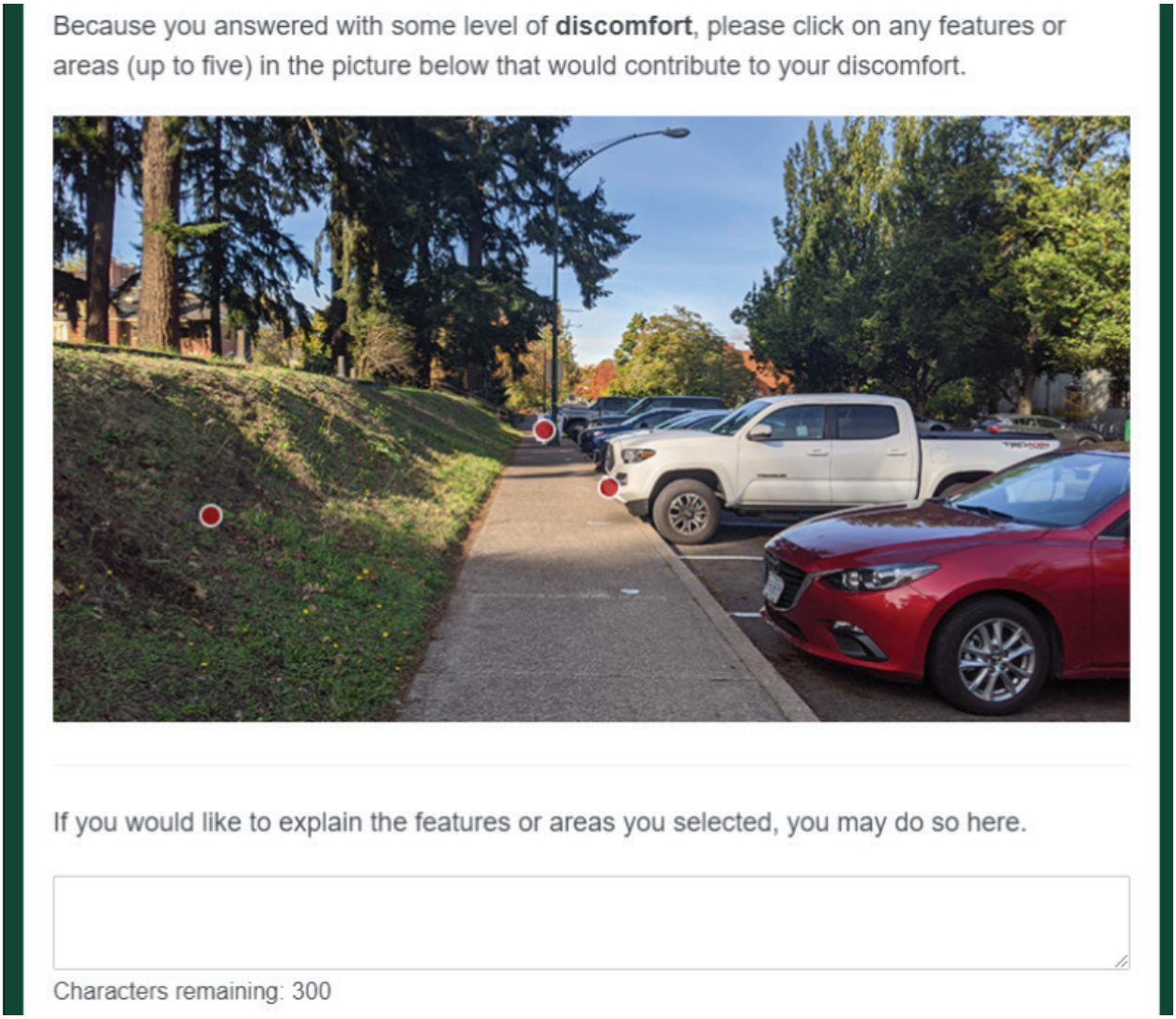


Figure 3.3: Heat Map Question Sample

The images selected to be included in the survey are from areas of Eugene where walking is a very common form of transportation, including the downtown and university areas with a few images from more residential neighborhoods as shown in Figure 3.5 on page 14. The purpose was to provide images where survey respondents could imagine themselves walking. The images chosen also portray a variety of street size, layout, planting, and furnishing designs. Some images show vertical separation between the sidewalk and the roadway, while some show a variety of seating options and arrangements. Some sidewalks are adjacent to the roadway, while some are separated by parking, bollards, bike lanes, or plants. Some of these separations are smaller, like a small grass strip of a thin strip of street trees, and others have a larger, more prominent right-of-way separation. The sidewalks shown are at a variety of widths, some only wide enough for two people to be side by side, some much wider, and one where there is no sidewalk. The goal of this variety of images is to gain an understanding at the detail scale. It is assumed that some type of separation between pedestrians and vehicles would be preferred, but the size, shape, and use of that separation may also play a role in comfort.

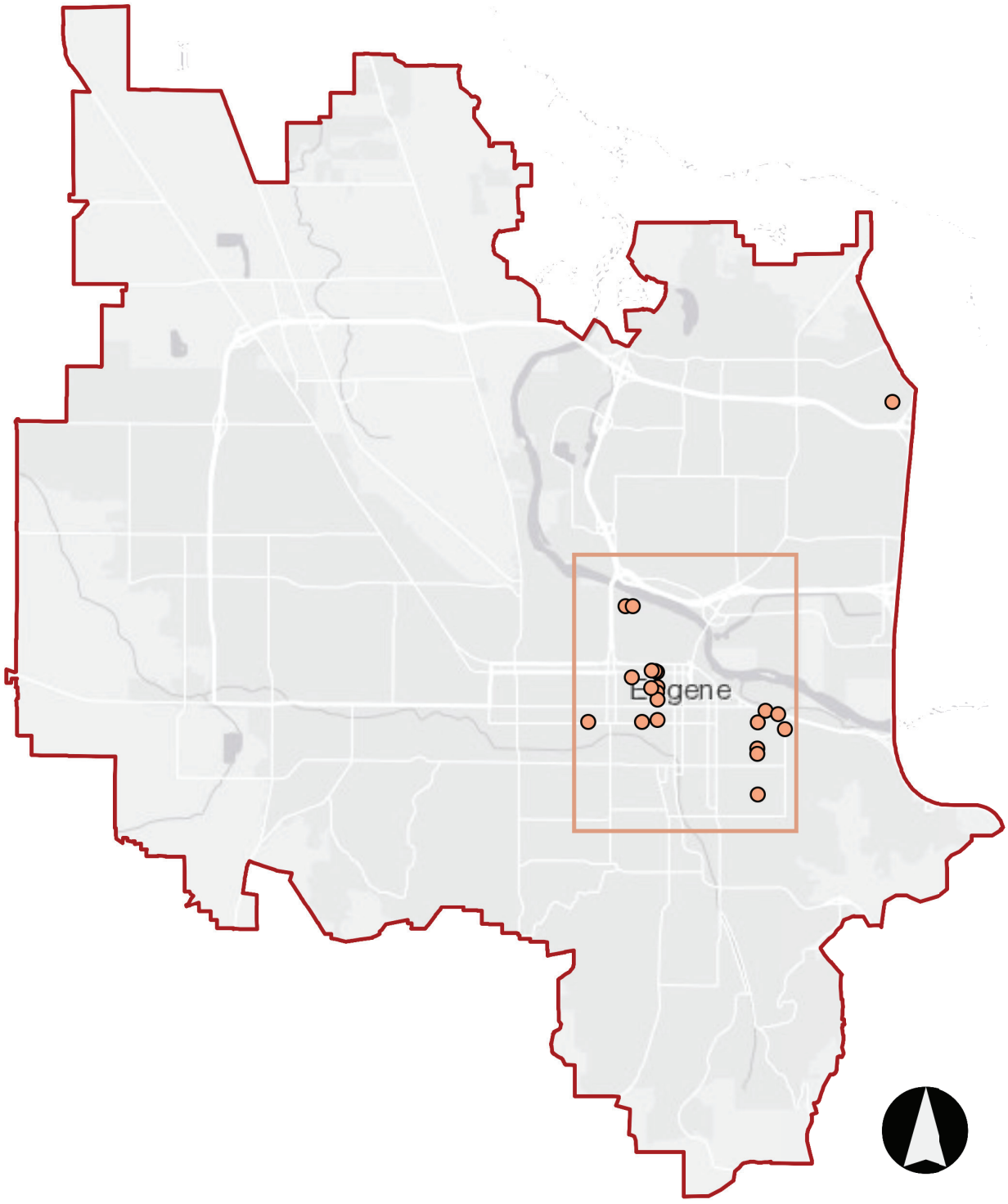


Figure 3.4: Survey Site Locations in Eugene

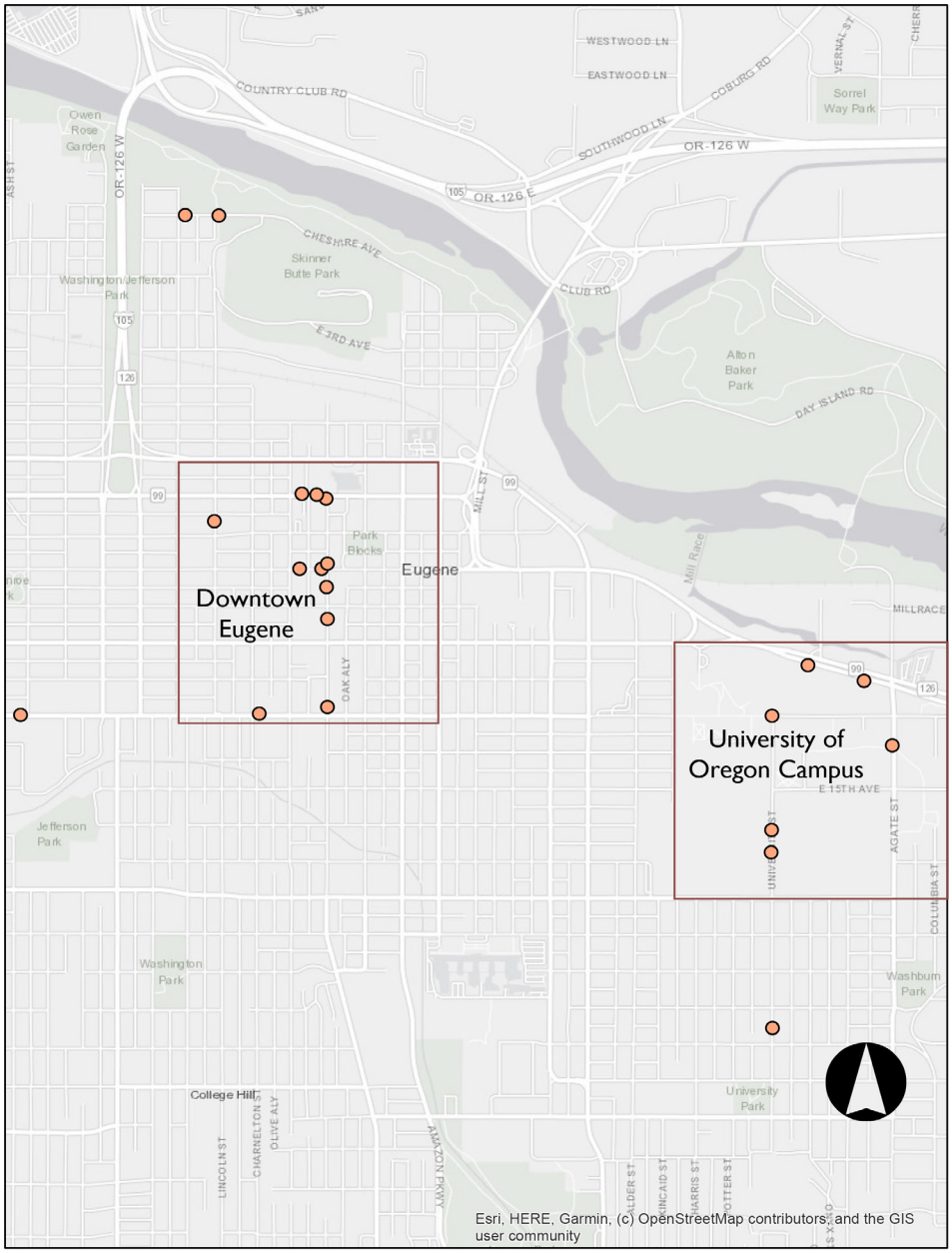


Figure 3.5: Survey Site Locations

3.2 Data Analysis

Data analysis occurred in two phases. The first phase focused on the numerical value that respondents gave to each image. Each image was analyzed for differences in perception by gender, within or outside of Eugene, and age, as well as compared across categories. The average ranking was found for each category and was used to find the most and least comfortable images, and to compare different demographic groups to determine whether different perception exists between them.

After the top six and bottom six images were identified for each group, the heat map questions of the survey were visually inspected. The data was brought into Tableau to filter it by gender, age, and location. This analysis was done to determine what design elements in each picture contributed to the level of comfort, thus generating typologies.

Figure 3.6: Data Analysis

Figure 3.7: Q6 Heat Map by Female (left) and Male (right)

Figure 3.8: Q6 Heat Map by Eugene (left) and Outside Eugene (right)

Figure 3.9: Q6 Heat Map by Ages 18-24 (left) and Ages 65+ (right)

3.3 Precedent Study

For the precedent study phase of the project, three design projects and two design guides were used to identify typologies for potential solutions to the negative typologies found in Eugene's streetscapes. The three design projects - Oklahoma City Innovation District, Times Square, and Dutch Kills Green – were used to find street design typologies that enhance safety and comfort for pedestrians. The two design guides – Reframing the Chinese Street as Public Space and National Association of City Transportation Officials (NACTO) Urban Street Design Guide – were used to collect additional typologies that may not have been included in the design projects.

3.4 Typology Generation

The six highest and six lowest ranked images were further analyzed to identify positive and negative typologies. These typologies were identified using the heat map questions on the visual preference survey. The areas with more clicks are shown in red for the lower ranked images, and blue for the higher ranked images. The areas with more clicks were then assigned a typology. For example, the image ranked 18th has a dark red spot over the driveway for the parking garage. This was understood to mean that the survey participants did not like that cars could be interacting with them in this space.

3.5 Design

The findings from the precedent study and typology generation were applied to three of the lowest ranked images. Each image was assessed using the negative typologies found for them and redesigned using positive typologies that addressed as many negative typologies as possible.

Findings

CHAPTER 4: Findings

4.1 Visual Preference Survey

The survey received a total of 549 responses. Of those responses, only the 408 complete responses were analyzed. 275 (67%) of the respondents were women, 116 (29%) were men, 11 (3%) were non-binary, and 6 (1%) answered other. Almost half of the respondents (46%) were ages 25-34. 21 percent of respondents were ages 35-44, 13 percent ages 45-54, 10 percent ages 18-24, 8 percent ages 55-64, and just two percent over the age of 65. The majority of survey respondents (87%) had no affiliation with the University of Oregon. The survey was distributed to people outside of Eugene to remove the bias of those who are familiar with the locations shown in the survey. People from Eugene were likely to judge the image based on their experiences in or near that space, including knowing the speed limit, experiencing loud noises or potent smells, or knowing the overall context of the space.

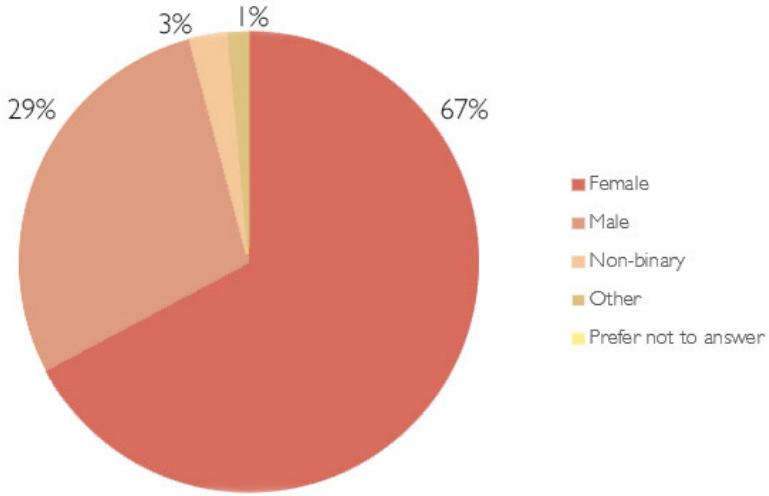


Figure 4.1: Survey Demographics: Gender

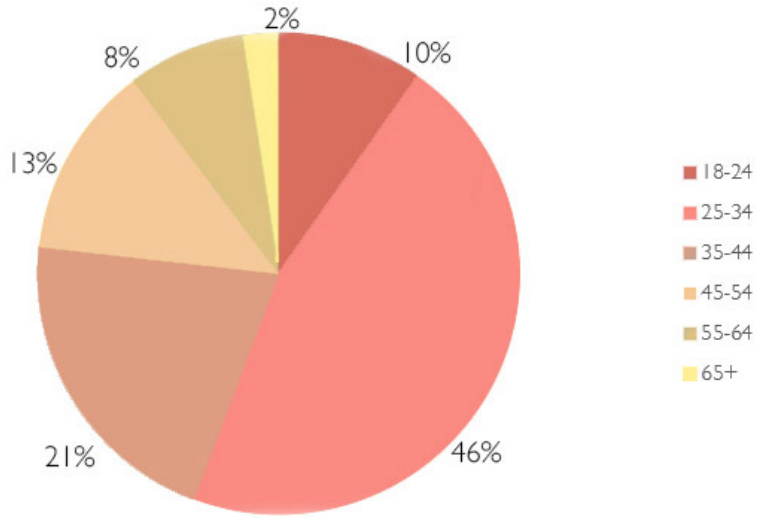


Figure 4.2: Survey Demographics: Age

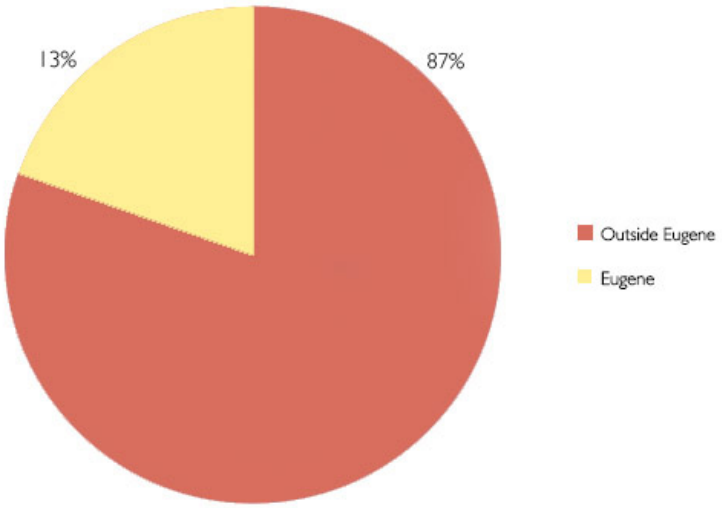


Figure 4.3: Survey Demographics: Location

4.2 Data Analysis

First, the data was organized by image. This was done by calculating the average rating for each image. Then, those ratings were further broken down by categories. These categories include gender, familiarity with Eugene, age, and combinations of those three. Once each image had an average rating for each group, the best six and worst six images were found for each category based on the rating.

In determining which images were the most positive or negative, there were some outliers for some categories. The first category that strayed quite a bit from the overall rankings was respondents who identified their gender as "other." This category likely had so many outliers because only six respondents identified with that category. A similar situation occurred with those in the "Male Eugene" and "65+" categories. The "Male Eugene" category is for anyone that has an affiliation with Eugene that identifies as male. There were only 12 respondents in this category. There were only 10 respondents who identified as being 65 or more years of age. Smaller populations strayed farther from the norm because it was easier for individuals to skew results.

The image from Q12 was negative for five groups. The image showed an outdoor dining tent during the COVID-19 pandemic that covered the full width of the sidewalk. This forced pedestrians to either walk through the tent past unmasked people, step into the street to walk, or turn around and walk another way. The image from Q14 was negative for one group and positive for another group. The image is from the downtown and showed picnic tables and planters in the sidewalk, but people walking in the street. The street was closed to cars at the time the image was taken which made the image more positive for those in the "Male Eugene" category. People walking in the street also implies that the street was more comfortable to walk on for those in the "Other" category because there were objects crowding the sidewalk. The image from Q16 was positive for the "Other" and "65+" groups. The image shows a sidewalk with a fence on one side and the street on the other, but there was mulch and grass on each side that provided space to step off the sidewalk without risk. The image from Q24 was positive for four groups. The image is from the University of Oregon campus where

there is a designed crossing for pedestrians with signage to encourage cars to slow down or stop. Although there were some outliers, in general, there were little to no differences observed by gender, age, or location in which images were found to be positive and negative.

	1	2	3	4	5	6	16	17	18	19	20	21
Male	Q19	Q6	Q9	Q22	Q21	Q28	Q13	Q27	Q17	Q7	Q20	Q15
Female	Q22	Q19	Q6	Q9	Q21	Q28	Q13	Q27	Q17	Q7	Q20	Q15
Non-binary	Q22	Q19	Q6	Q9	Q21	Q28	Q27	Q7	Q12	Q17	Q20	Q15
Other	Q10	Q6	Q9	Q16	Q19	Q21	Q13	Q7	Q14	Q12	Q15	Q20
Eugene	Q19	Q22	Q28	Q9	Q6	Q24	Q13	Q27	Q17	Q7	Q20	Q15
Non-Eugene	Q22	Q19	Q6	Q9	Q21	Q28	Q13	Q27	Q17	Q7	Q20	Q15
Female Eugene	Q19	Q22	Q6	Q28	Q21	Q9	Q11	Q13	Q7	Q17	Q20	Q15
Fem non-Eugene	Q22	Q9	Q6	Q19	Q21	Q24	Q13	Q27	Q17	Q7	Q20	Q15
Male Eugene	Q9	Q21	Q19	Q24	Q14	Q22	Q13	Q17	Q7	Q27	Q20	Q15
Male non-Eugene	Q6	Q19	Q22	Q9	Q21	Q28	Q12	Q27	Q17	Q7	Q20	Q15
18-24	Q22	Q6	Q9	Q28	Q21	Q19	Q13	Q27	Q17	Q7	Q20	Q15
25-34	Q22	Q9	Q19	Q6	Q21	Q28	Q12	Q27	Q17	Q7	Q20	Q15
35-44	Q19	Q6	Q9	Q21	Q28	Q22	Q13	Q27	Q17	Q7	Q20	Q15
45-54	Q19	Q22	Q6	Q9	Q28	Q21	Q13	Q27	Q17	Q7	Q20	Q15
55-64	Q19	Q21	Q22	Q28	Q6	Q16	Q27	Q17	Q7	Q13	Q20	Q15
65+	Q19	Q22	Q16	Q21	Q6	Q24	Q7	Q12	Q27	Q13	Q20	Q15
Overall	Q19	Q22	Q6	Q9	Q21	Q28	Q13	Q27	Q17	Q7	Q20	Q15

Table 4.1: Image Rankings by Group

Differences in Perception by Gender

There were no significant differences between the perceptions of comfort between men and women. There were some differences for people who did not identify as male or female, but the number of participants who fit into this category was not enough to perform a statistical analysis.

Figure 4.4: Lowest Ranked Image for Both Male and Female

Figure 4.5: Highest Ranked Image for Male (left) and Female (right)

While men and women did not have differing opinions of which image was the least comfortable, there was a difference between which image they found to be overall more comfortable. The male respondents favored a more residential neighborhood with manicured landscaping and plenty of space between the sidewalk and the street. The female respondents, on the contrary, favored a wide-open street that was closed to cars. A follow-up survey could be deployed to identify why,

but perhaps women prefer to walk in places where other people are probably also walking, which contributes to both the level of comfort and the safety of that streetscape.

Differences in Perception by Familiarity

The differences between the perceptions of those who live in Eugene and those who do not were very slight. The locations chosen on the heat maps had subtle differences on some photos, which suggests that prior experiences in a place effect perception of comfort.

Figure 4.6: Lowest Ranked Image for Both Eugene and Outside Eugene

Figure 4.7: Highest Ranked Image for Eugene (left) and Outside Eugene (right)

Whether residing in Eugene or not, the lowest ranked image was the same. The least comfortable image based on location was, again, the image without a sidewalk. Those who either live in or have some affiliation with Eugene, Oregon favored the image from a manicured residential neighborhood. Those who were not familiar with Eugene favored the image from the University of Oregon's campus of a pedestrian street. It is interesting that men and those residing in Eugene ranked the same image as the most comfortable, and it was also the same for women and those not familiar with Eugene.

Differences in Perception by Age

Perceptions varied the most by age group. The heat maps had slight variation on how significant the elements were clicked on. However, the number of respondents per age group varied greatly.

Figure 4.8: Lowest Ranked Image for All Ages

Figure 4.9: Highest Ranked Image for Ages 18-34 (left) and 35+ (right)

The highest and lowest ranked images were consistent among age groups. The images in between were much more varied. This suggests that street design elements are perceived differently by age. Younger groups preferred to be separated from cars as much as possible.

Lowest Ranked Images

The image from Q15 was ranked the lowest (Image #21). It is located in front of a city park that is on the Willamette River, and also sits within a residential neighborhood. This location is lacking any clear place for people to walk.

The image from Q20 was ranked 20th out of 21 (Image #20) and is a concrete strip that separates a four-lane one-way road from a drive through in front of the Hult Center, a theater in Downtown Eugene. The drive through is typically used as a drop off point for tour buses. This concrete strip also serves as a space where pedestrians wait to cross this busy road.

The image from Q7 was ranked 19th out of 21 (Image #19). It is located on a quieter one-way street in front of a carpet store. The carpet store has a large surface area where there are no windows, and the building blocks visibility to the alley just behind it. The sidewalk is wide here, but the street pole just ahead suggests that the intended pedestrian space is only on the left side.

The 18th ranked image (Image #18) is from Q17. It is on the same busy street as Image #20 and is in front of the parking garage that serves that same theater. It is dark inside the parking garage, and the hedge and trees on either side of the sidewalk create a tight-feeling space.

The 17th ranked image (Image #17) is from Q27 and is of a high-traffic road near the University of Oregon campus. The road has seven lanes of traffic, making it generally unattractive for pedestrians. The bus stop in the image is no longer in service, leaving the bench without its original purpose.

The 16th ranked image (Image #16) is from Q13. It is of a sidewalk that sits very close to the adjacent apartment building located in Downtown Eugene. There is also a new cycle track in this image between the sidewalk and the car lanes.

	16	17	18	19	20	21
Hiding Places		x	x			
Obstacles				x	x	
No Space	x	x	x		x	
No Separation		x			x	x
Curb Cut			x	x		
Uneven Surface	x			x		x

Table 4.2: Negative Images by Comparison

Figure 4.10: Lowest Ranked Images

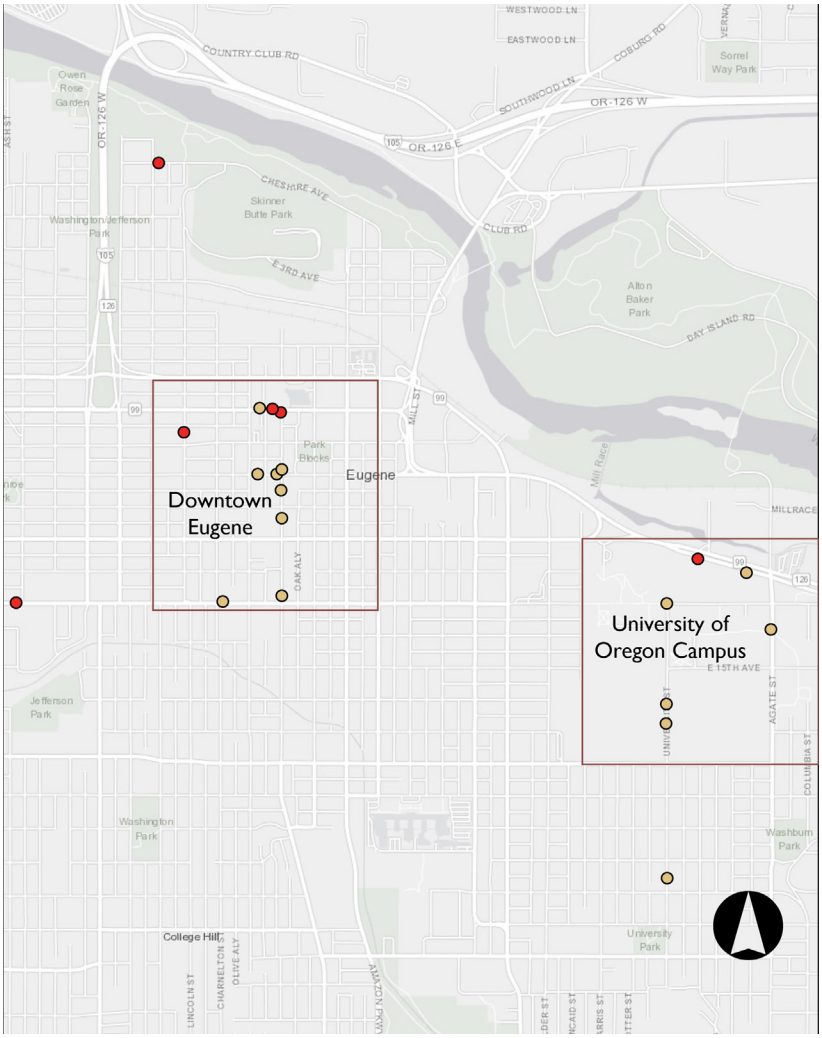


Figure 4.11: Lowest Ranked Images Map

Key Findings From Lowest Ranked Images

The most noteworthy finding is that four out of the six negative images show an uneven walkway. This includes having no sidewalk, having a sloped sidewalk or curb cut, or a change in the sidewalk material. Additionally, two out of the six images include a driveway where vehicles can interact with pedestrians. Two of the six images do not include any separation between the walkway and the roadway. Some of the sidewalks in this group are narrow and do not provide enough space to step aside to let others pass. Some of these images also lack "eyes on the street."

Highest Ranked Images

The image from Q19 was the highest ranked image (Image #1). It is located on a higher income street in a residential neighborhood near the University of Oregon campus. This sidewalk is an average width of about four or five feet and sits well separated from the roadway by lawn and large street trees. The pedestrians are far from cars, which reduces their visibility, but also reduces the risk of having to interact with one.

The image from Q22 was the second highest ranked image (Image #2). It is a pedestrian and bike only street located on the University of Oregon campus. The site features bike racks, ample lighting, large trees, and wayfinding – all features that imply the space has been designed for people, not cars.

The image from Q6 was the third highest ranked image (Image #3) and is located in front of an apartment building in downtown Eugene. The street is generally busy with pedestrians, cyclists, and drivers. The site features large concrete bollards, well-kept brick paving, and decorative shrubs.

The image from Q9 was ranked the 4th highest (Image #4) and is located outside of a brewery in the downtown center. The site features seating, lighting, wayfinding, and concrete planters all on a wide sidewalk. Being at an intersection, pedestrians are highly visible to other pedestrians, cars, and consumers.

The image from Q21 was ranked the 5th highest (Image #5) and is just around the corner from Image #4 in the downtown center. The image used was taken during a weekend event that closed the street to vehicles.

The image from Q28 was ranked the 6th highest (Image #6) and is another image located in downtown Eugene. This image is in front of a popular chocolate shop.

	1	2	3	4	5	6
Trees	x	x	x	x	x	x
Lighting			x	x	x	
Seating				x	x	
Separation	x		x	x	x	x
Wayfinding		x		x		
Space	x	x			x	x
Cues to Care	x		x	x	x	x

Table 4.3: Positive Images by Comparison

Figure 4.12: Highest Ranked Images

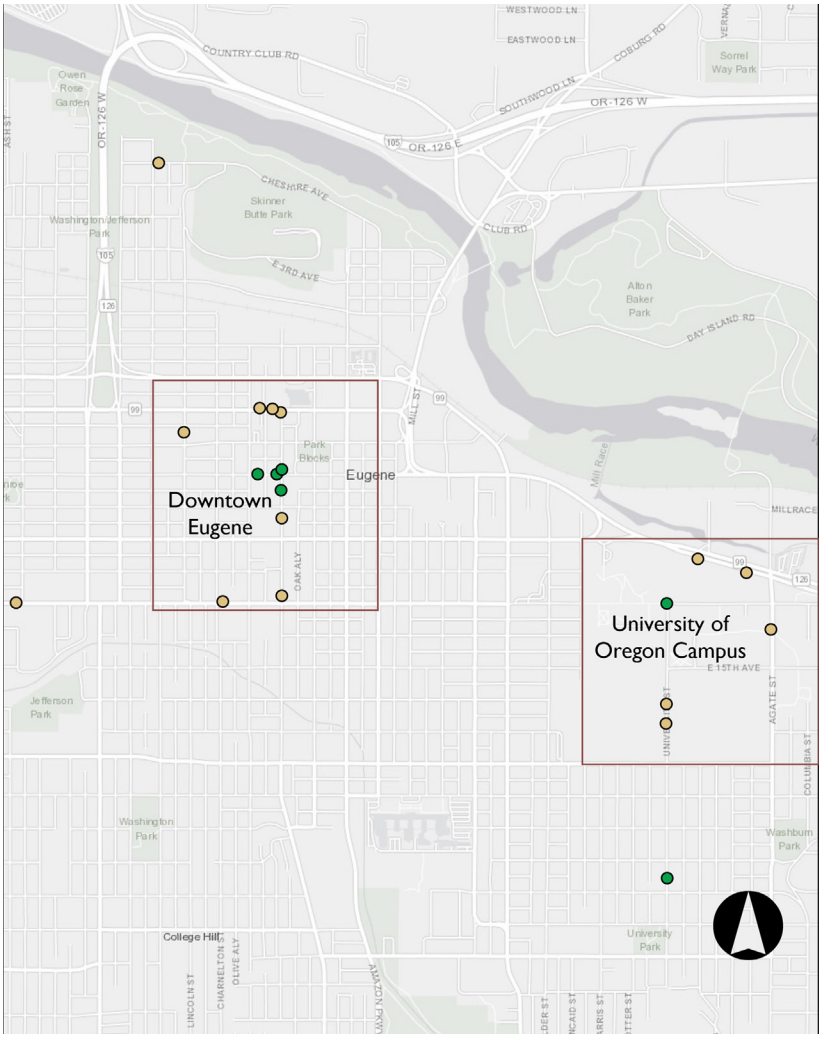


Figure 4.13: Highest Ranked Images Map

Key Findings From Highest Ranked Images

Four of the top six images are from Eugene's downtown. Of these four, two include parking meters and parallel parking that separate the sidewalk from car traffic. Only one of the four has outdoor seating space in the streetscape. Two of these four images from the downtown have large concrete structures, either planters or bollards, that provide vertical separation from traffic. All four of the streets from the downtown have significantly wide sidewalks. An additional key finding from the highest ranked images is that two of the images are of streets that are closed to car traffic.

Heat Maps Analysis

In analyzing the heat maps, it became clear that "comfortable" street design minimizes a sense of risk from three different interactions: human-human, human-vehicle, and human-environment.

Things that could cause negative human-human interactions include hiding places, a lack of space, and a lack of eyes on the street. Hiding places could be corners of buildings, dense vegetation, or anywhere lacking adequate lighting. A lack of space can cause negative human-human interactions

if there is not enough room to step to the side to allow others to pass by, or to plan an escape in case of danger or an emergency. A lack of eyes on the street can lead to dangerous people gaining confidence that they can cause harm without getting caught. Positive human-human interactions can occur where there is adequate lighting, seating, eyes on the street, and enough space for people to pass by one another.

Human-vehicle interactions can occur in spaces where a driveway crosses a sidewalk, or where there is no separation between the sidewalk and the street, leaving pedestrians vulnerable to cars potentially veering onto the sidewalk. Positive human-vehicle interactions can occur with the presence of street trees, planters, bollards, or anything else that provides separation between the two user groups.

Examples of negative human-environment interactions are obstacles on the sidewalk, an uneven sidewalk surface, unattractive or unmaintained plants, or a pedestrian environment that is out of scale. Positive human-environment interactions can occur with large trees, decorative shrubs, bike parking, wayfinding, wide walkways, and cues to care.

4.3 Precedent Study

NACTO Urban Street Design Guide

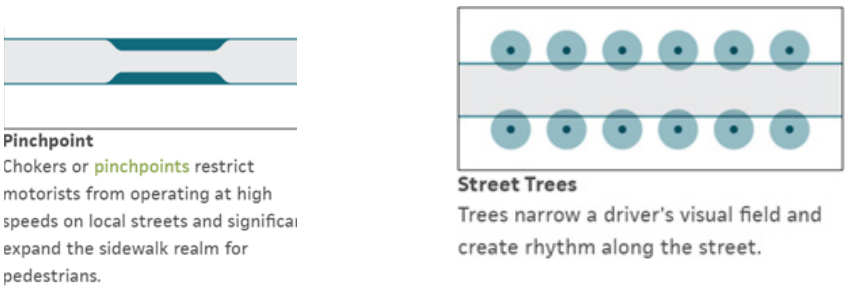


Figure 4.14: Pinchpoint (left) and Street Trees (right) (National Association of City Transportation Officials, "Urban Street Design Guide.")

The NACTO Urban Street Design Guide is a guidebook made specifically for designing streets for all users. This design guide was made under the belief that human behavior is adaptable, and changing streets can change human behavior (National Association of City Transportation Officials, "Urban Street Design Guide."). Some general recommendations from the design guide are to use human-scale lighting, place benches along buildings, and provide shade with awnings and street trees (National Association of City Transportation Officials, "Urban Street Design Guide."). Recommendations specifically for slowing traffic are using pinch points, street trees, on-street parking, and medians wherever possible (National Association of City Transportation Officials, "Urban Street Design Guide."). Typologies found from this precedent include street trees and traffic calming measures like pinch points.

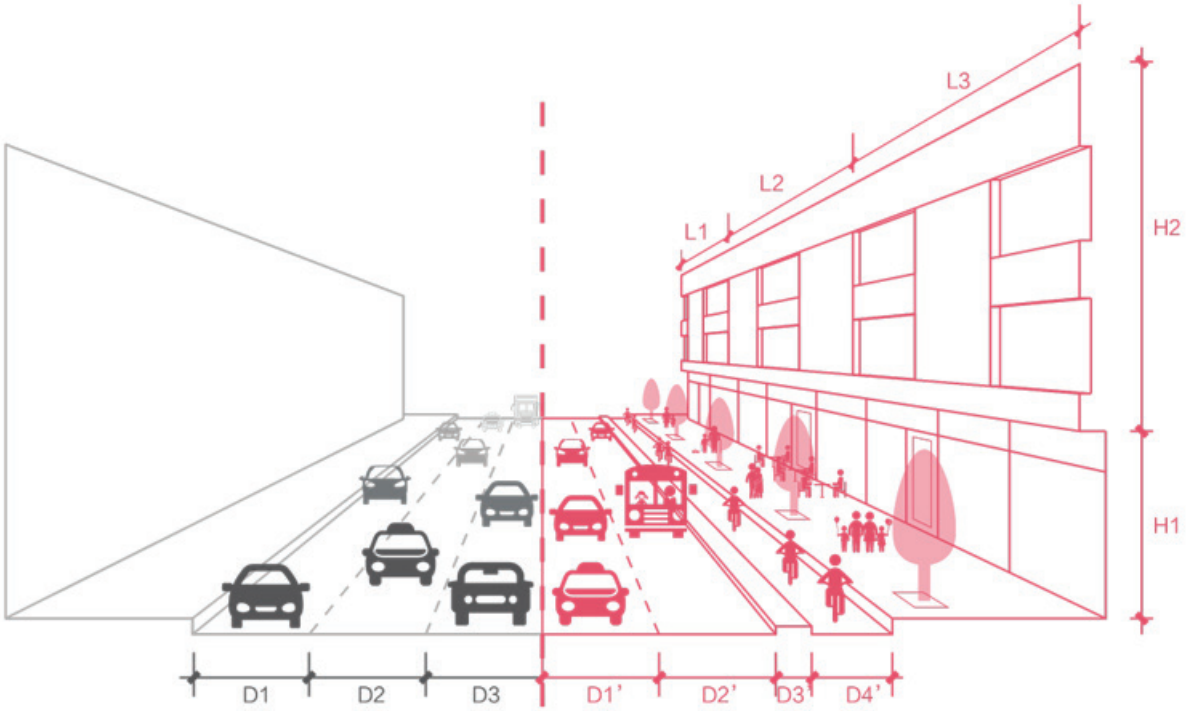


Figure 4.15: Walkable Street ("Projects.")

Figure 4.16: Steet Typologies ("Projects.")

As a society, we are urbanizing at a very fast pace on this quest for exponential economic growth ("Projects" n.d.). This has pushed street designers to prioritize transport infrastructure over people and public use ("Projects" n.d.). The guide produced for this project is different than many design guides because it does not follow the "one size fits all" principle ("Projects" n.d.). It acknowledges that streets have a variety of uses including walking, sitting, people watching, shopping, eating, waiting, taking photos, etc. ("Projects" n.d.). With different uses comes the need for different facilities for things like easy and safe crossing, sitting and playing, and wayfinding ("Projects" n.d.). Arguably the most important recommendation from the guide is that streets be customizable, meaning they are flexible and can accommodate a variety of uses at any given time. Typologies found from this precedent include shade, seating, and wayfinding.

Figure 4.17: Aerial View of Dutch Kills Green ("WRT | Planning + Design | Dutch Kills Green.")

Figure 4.18: Dutch Kills Green Site Plan (Landscape Architecture Foundation, "Dutch Kills Green.")

Dutch Kills Green is a project done by WRT Planning & Design in Queens, New York. Formerly known as the "Boulevard of Death", this project decreased the number of pedestrian deaths at this site from 18 per year in 1997 to zero in 2011 (Landscape Architecture Foundation, "Dutch Kills Green."). This area of Queens is an entanglement of streets and elevated trains (Kensinger, "Exploring Queens Plaza's New Dutch Kills Green Park."). The park replaced a parking lot, and a bike path and median were added to increase overall safety (Kensinger, "Exploring Queens Plaza's New Dutch Kills Green Park."). Social benefits include a 12% increase in bicycle traffic since 2011, reduced fatalities as stated previously, and a 23% reduction in ambient noise (Landscape Architecture Foundation, "Dutch Kills Green."). Economically, the project is estimated to provide $2000-3700 in net annual benefits to the city from reduced energy consumption, improved air quality, carbon storage, and increased property values (Landscape Architecture Foundation, "Dutch Kills Green."). Typologies found from this precedent include green spaces and physical separation from vehicles like bike lanes, concrete barriers, and benches..

Times Square – Projects for Public Spaces

Figure 4.19: Times Square Before and After ("Times Square.")

Projects for Public Spaces used a time-lapse video and surveys to analyze the space and better understand the district ("Times Square | Projects — Project for Public Spaces."). The time-lapse video was used to map the different user activities that occurred throughout the day ("Times Square | Projects — Project for Public Spaces."). Through their analysis they found that the traffic median, sidewalks, and adjacent buildings were not meeting pedestrian needs, and recommended reconfiguring the road with new architectural treatments and pedestrian amenities ("Times Square | Projects — Project for Public Spaces."). Janette Sadik-Kahn, head of NYCDOT at the time, closed several sections of the street to car traffic and had them filled with tables, seating, and other pedestrian amenities ("Times Square."). Typologies found from this precedent include seating and space to spread out.

Figure 4.20: Oklahoma City Innovation Plaza (Project for Public Spaces n.d.)

Oklahoma City is becoming a hub for energy and health care innovation (Walker 2017). Project for Public Spaces partnered with Brookings Institution to examine the physical, social, and economic assets in an emerging innovation district (Project for Public Spaces n.d.). The 1.3 square mile district both the Oklahoma Health Center and an already vibrant commercial corridor (Walker 2017). This project used a combination of Geographic Information Systems, user observations, surveys, and placemaking workshops, and focused on short-term activations as well as long-term shifts in land-use and traffic engineering to create a dense, walkable, mixed-use development (Project for Public Spaces n.d.). Recommendations for the project included adding gathering spaces and outdoor play opportunities, strengthened connections with landscaping, lighting, and bicycle and pedestrian improvements (Walker 2017). Typologies found from this precedent include planters and lighting.

	NACTO	Chinese Street	Dutch Kills Green	Times Square	OKC Innovation
Green space			×		×
Concrete Barrier			×		×
Street Trees	×	×	×		×
Shade	×	×	×		×
Median	×		×		
Gathering space			×	×	
Lighting	×	×			×
Street Closure				×	
Seating	×	×	×	×	
Wayfinding		×			
Space			×	×	
Dedicated Lanes		×	×		×
Traffic Calming	×				
On-Street Parking	×				
Safe Crossings		×		×	×
Separation		×	×		

Table 4.4: Precedent Typologies

4.4 Typology Generation

The typologies found for each precedent are shown in Table 4.5. The six best and six worst ranked images were analyzed for elements using the heat maps from the visual preference survey. Areas on the heat map images that were darker indicate that they were clicked on by more participants and identified as something that made participants more or less comfortable. The typology found for the lowest ranked images is shown in Table 4.6, and the typology found for the highest ranked images is shown in Table 4.7.

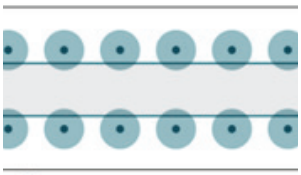
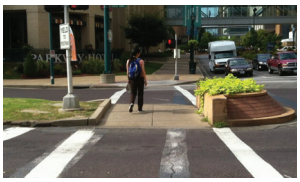
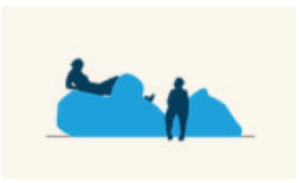
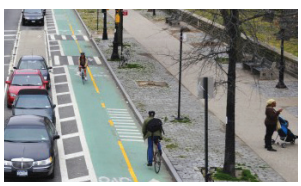
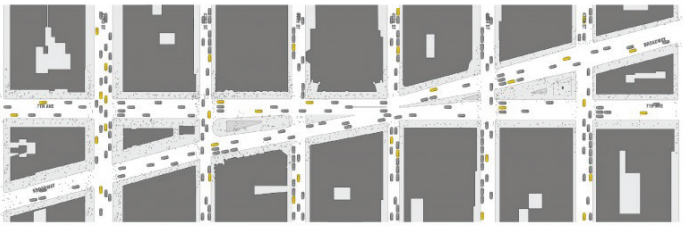
	Human-Human	Human-Vehicle	Human-Environment
Vegetation	Green Space 	Planter Barrier 	Shade 
		Street Trees 	Median 
Furnishing	Gathering Space 	Street Closure 	Seating 
	Lighting 		Wayfinding 
Layout	Space 	Traffic Calming 	Safe Crossings 
	Dedicated Lanes 	On-Street Parking 	Separation 

Table 4.5: Precedent Typology Examples


Dutch Kills Green


Before

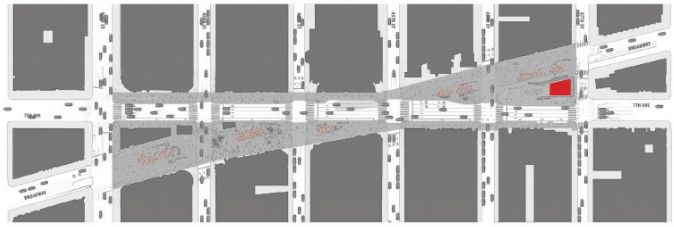

Times Square 2017

Figure 4.21: Precedents

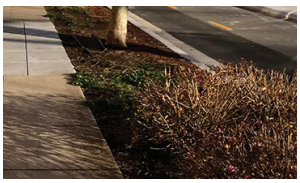
	Human-Human	Human-Vehicle	Human-Environment
Vegetation			Unmaintained plants A 
Furnishing	Hiding places B 		Obstacles C 
Layout	Lack of space D 	Curb cuts F 	Uneven surface H 
	No eyes on street E 	No separation G 	Out of scale I 

Table 4.6: NegativeTypology

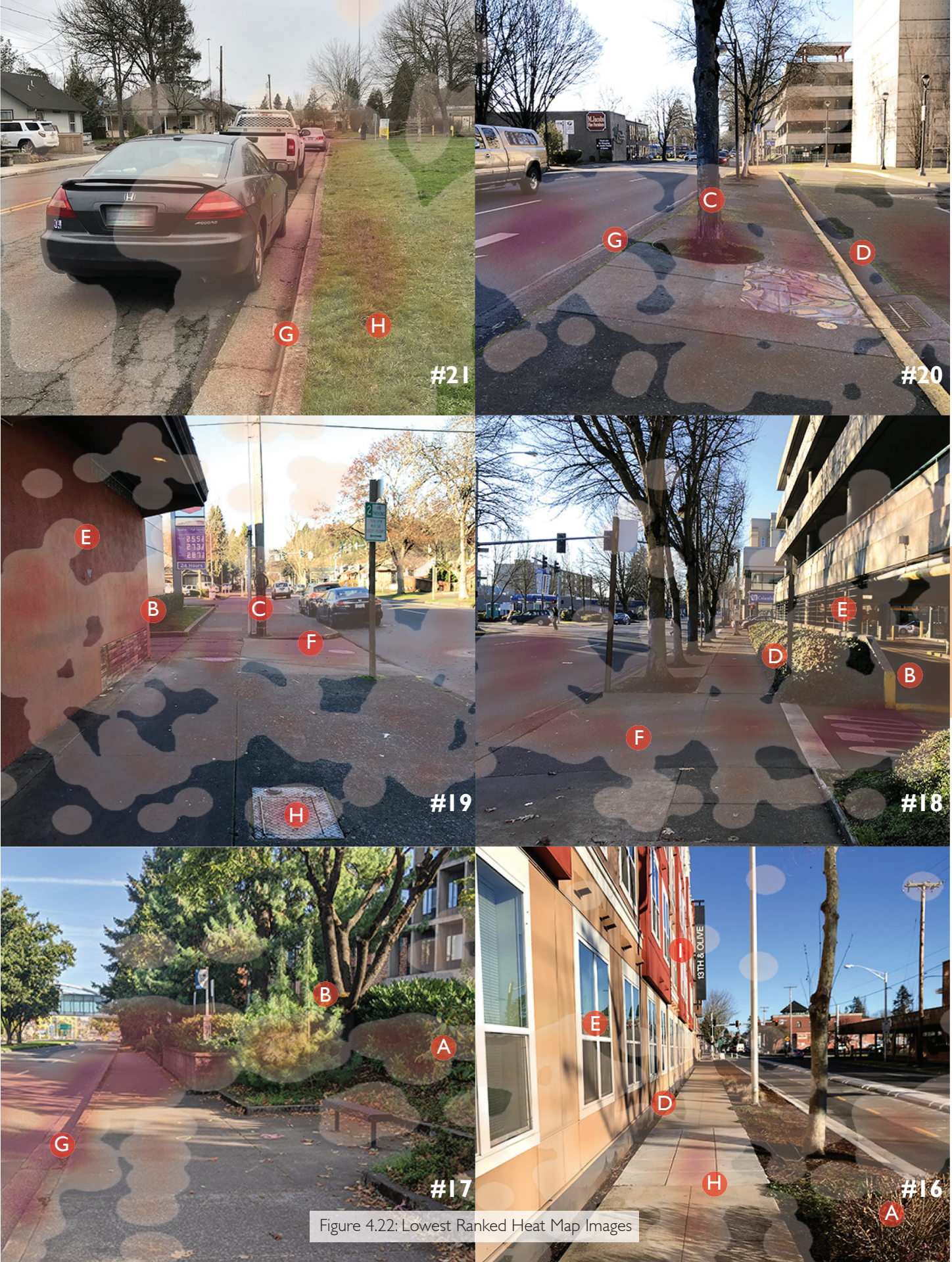


Figure 4.22: Lowest Ranked Heat Map Images

	Human-Human	Human-Vehicle	Human-Environment
Vegetation		Street Trees J 	Large Trees L 
		Planters K 	Decorative Shrubs M 
Furnishing	Lighting N 	Bollard P 	Bike Parking Q 
	Seating O 		Wayfinding R 
Layout	Eyes on the Street S 	Separation U 	Wide Sidewalk V 
	Space T 		Cue to Care W 

Table 4.7: Positive Typology

Figure 4.23: Highest Ranked Heat Map Images

Human-human Interactions

People are more comfortable when they can see potential danger and can plan a way to avoid it. The longer the line of sight the better. Hiding places can be found adjacent to buildings or in some types of vegetation and can be solved with proper lighting and more transparent vegetation. This can include using trees with thin trunks, while dense shrubs should be avoided. Providing enough space is also important. Somewhere to step off the path to allow others to pass is considered more comfortable. No added space can make people feel threatened or feel stuck if there is a potential threat and no safe way to escape.

Human-vehicle Interactions

Cars are large, dangerous transportation vehicles that can be very threatening to people if unprotected. Any type of separation is better than none. Separation can be vertical with bollards or planters, horizontal with a grass strip or bike lane, or more functional like parking meters or bike racks. Multiple lanes should have increased separation. Anywhere a car can cross over the sidewalk is not comfortable, and measures should be taken to be sure that pedestrians in this situation are visible to drivers.

Human-environment Interactions

Human-environment interactions are the most controlled by street designers. Small cues to care, like well-maintained plants and carefully selected materials can imply that the place is well cared for. The surface material should be smooth without large cracks or a slope. Brick is an appreciated material because it is a cue to care, but there are other cues to care that can be used. Maintenance is also important, as wet leaves or trash can become a hazard. Landscape elements should be placed carefully as to not block any part of the walkway. A place to sit provides a comfortable option, but the placement of the seating element is critical. Seating that blocks part of the walkway can create obstacles for other people, but seating that is tucked away can feel hidden.

Synthesis

Three negative images were chosen to be redesigned based on the typology findings. The typologies associated with the three images were addressed by either removing them or adding positive typologies to improve overall level of comfort.

CHAPTER 5: Design Solutions

5.1 Image #21

Figure 5.1: Image #21 Before

Figure 5.2: Image #21 Heat Map

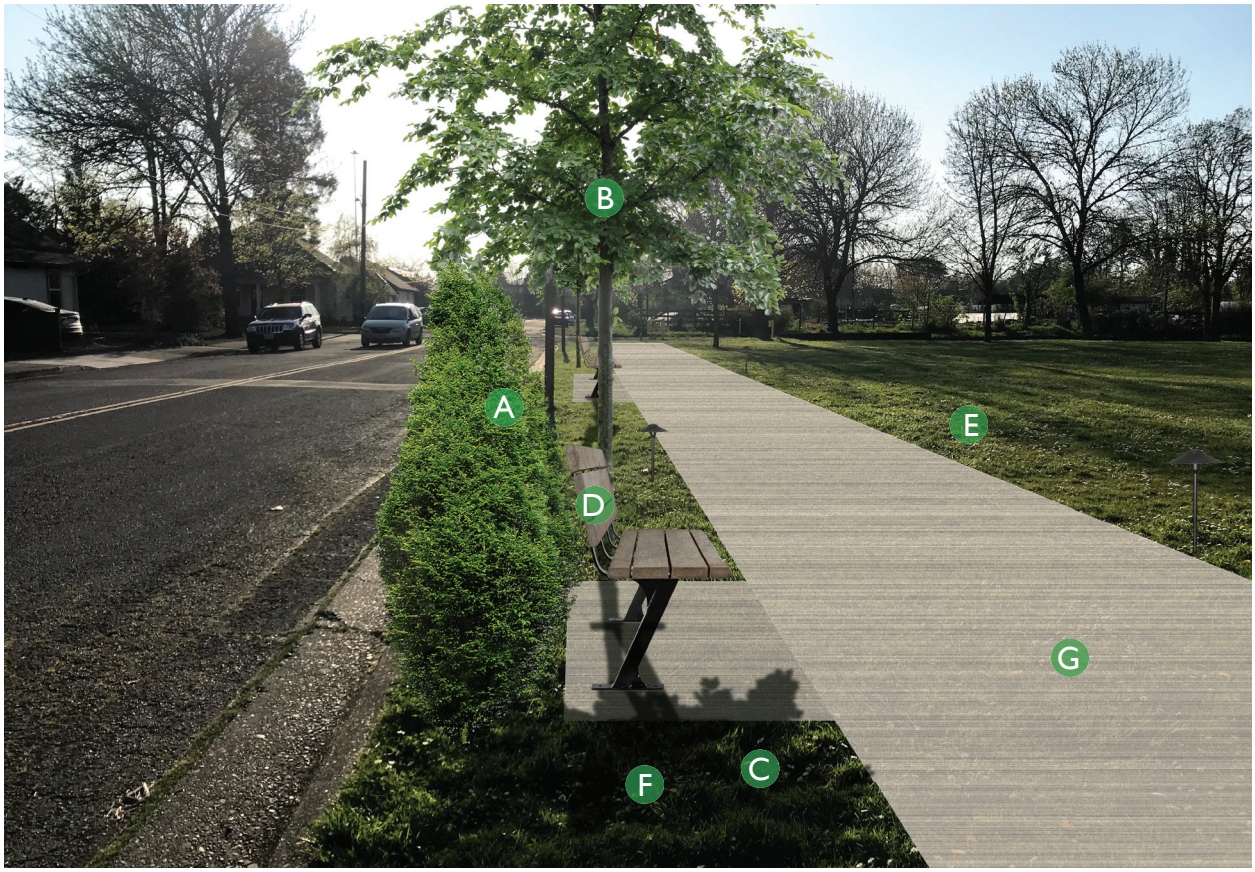


Figure 5.3: Image #21 After

Image #21 was the lowest ranked image. Image #21 is located in front of a city park that is on the Willamette River, and also sits within a residential neighborhood. Without any designated place for people, the first recommendation for this location is to put in a wide sidewalk for people to walk. The sidewalk is placed away from the street to allow space in between for street trees and seating. Street trees will provide shade and physical separation from cars passing by. Screening shrubs should be placed behind the benches to provide comfort in knowing that no one can sneak up behind people sitting there. Low path lights will increase comfort and safety at night without disturbing neighbors on the other side of the street.

	Human-Human	Human-Vehicle	Human-Environment
Vegetation	Green Space A 	Street Trees B 	Shade C 
Furnishing	Seating D 		
Layout	Space E 	Separation F 	Wide Sidewalk G 

Table 5.1: Positive Typology

5.2 Image #19

Figure 5.4: Image #19 Before

Figure 5.5: Image #19 Heat Map

Figure 5.6: Image #19 After

Image #19 is located on a one-way street in front of a carpet store. The carpet store has a large surface area where there are no windows, and the building blocks visibility to the alley just behind it. The sidewalk is wide here, but the street pole just ahead suggests that the intended pedestrian space is only on the left side.

Picking up debris and power washing the concrete can go a long way. Highlighting the driveway for the alley makes it clear for cars and pedestrians to be cautious of each other in this space. Adding a mural on the blank red wall adds a sense of community and belonging for pedestrians. Adding street trees provides a physical barrier between pedestrians and car traffic, while adding shade and greenery to this concrete-intensive space. The tree pits should be at least five feet square to provide enough space for the trees to continue to grow. Lining the tree pits with brick is a cue to care and encourages people to treat this space respectfully. Finally, adding a long concrete planter along the edge of the building adds more greenery, provides a place to sit, and makes the space feel more human-scaled. Unfortunately, the utility grate in the middle of the sidewalk is likely far too expensive to move. Fortunately, the grate is flush with the sidewalk and mainly an eyesore.

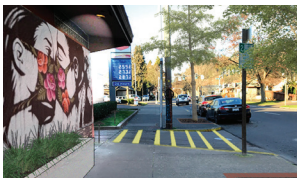
	Human-Human	Human-Vehicle	Human-Environment
Vegetation		Street Trees A 	Decorative Shrubs B 
Furnishing	Lighting C 		Seating D 
Layout		Separation E 	Cue to Care F 

Table 5.2: Positive Typology

5.3 Image #18

Figure 5.7: Image #18 Before

Figure 5.8: Image #18 Heat Map

Figure 5.9: Image #18 After

Image #18 is on the same busy street as Image #20 and is in front of the parking garage that serves that same theater. It is dark inside the parking garage, and the hedge and trees on either side of the sidewalk create a tight-feeling space.

Again, picking up debris and power washing the sidewalk can make a huge difference. Paint is used here as well to highlight the driveway for the parking garage exit to alert both drivers and pedestrians to exercise caution here. The hedges are removed on the right side of the sidewalk to allow for a wider walking space. Decorative concrete planters are placed on the left side of the sidewalk in between the street trees to provide additional barriers between pedestrians and cars on the street. The planters are placed as close to the street at possible to allow pedestrians to step to the side if needed to allow others to pass. Additional lighting is placed at the exit point of the parking garage to increase visibility for both drivers and pedestrians. Finally, a theater-themed is applied to the façade of the parking garage to improve the appearance and root the building in the context of its use.

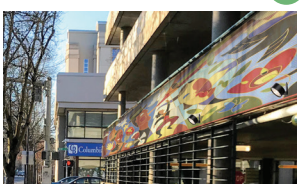
	Human-Human	Human-Vehicle	Human-Environment
Vegetation		Planters A 	Street Trees B 
Furnishing	Lighting C 		
Layout	Space D 	Safe Crossings E 	Cue to Care F 

Table 5.3: Positive Typology

Conclusion

CHAPTER 6: Conclusion

6.1 Limitations

While the findings in this project are useful in understanding differences in perceptions of street design, there are some limitations to this research. First, using a visual preference survey only allowed for understanding perceptions of a frozen landscape. Still images exclude context, and are not able to represent other senses like scent or sound. Still images are also a snapshot in time, and do not accurately represent the landscape at other times, such as during peak occupancy or at night. Second, the order of the images were not randomized due to conditional formatting of the survey. This possibly led to persuasion of the following questions where participants would respond highly or poorly to an image because they were comparing it to the prior image. The ability to randomize the order of the images for each respondent would have alleviated this concern.

Third, the survey was generally effective, but should be revised for future use. The heat map functions worked well because they allowed respondents to visually identify areas that contributed to their level of comfort, whether they could identify the specific element or not. Asking about comfort level was helpful, but it was not enough. Women do not perceive streets differently from men, yet they use them differently. A follow-up question to the comfort score should ask whether or not the respondent would still walk down it.

The presence of people in public spaces improves safety and comfort. Unfortunately, the images used in the survey were taken during the COVID-19 pandemic when the state of Oregon was in various stages of lockdown. As a result, most of the images do not have people in them. This was not intentional, but likely plays a role in the survey data. Further studies could include using repeated images rendered with a variety of people to understand the perceptions of having a lot of people for comparison. This would be especially interesting following the COVID-19 pandemic.

6.2 Further Inquiry

A second survey would need to be produced and distributed showing the redesigned images to determine if the design solutions improved perceptions of the space. This would start a feedback loop to continue to test if the identified typologies are successful.

The intent of this project was to begin the process of discovering why streets can be so uncomfortable for women. This project discovered that perceptions did not differ by gender, but men still use the streetscape more than women. The key difference to why that difference exists is yet to be determined. Women should be considered a "keystone species," meaning that if the streetscape is comfortable for women and they are using it, then it is comfortable for all users. Women, like all keystone species, can be used as an indicator for other vulnerable populations. A lack of women using a streetscape suggests that the design is poor and inequitable, while a streetscape with women users indicates a good and equitable design for all populations.

This project could be taken further by standing near the image locations and observing. Data collected could be counts of people by gender and age group and by how many people walk alone as opposed to with others, as well as how long people stay in the area. Other information to gather to move this research forward is racial data. Racial data was excluded from this study because it was not the focus of the research, but it is an important factor that could affect perceptions of a place and should be explored.

6.3 Transferability

While this project is based in Eugene, Oregon, the use of precedents allows this project to be transferred to other regions. The typologies found and used in the design solutions are all common elements already used throughout the country, and therefore can be applied to any streetscape in the United States. Although, the findings from this study may not apply to areas outside of the United States or other Western cultures. Cultural differences may impact perceptions of safety and comfort in different streetscapes. Specifically, the role of women in other cultures impacts how they use streetscapes, and thus impacts access and safety as well.

"If you plan cities for cars and traffic, you get cars and traffic. If you plan cities for people and places, you get people and places." – Fred Kent, Founder and President of Projects for Public Spaces

Appendices

APPENDICES

Appendix A Raw Survey Results
Appendix B References

Appendix A: Raw Survey Results

	Q4	Q5	Q6	Q7	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q19	Q20	Q21	Q22	Q23	Q24	Q27	Q28
Male	3.26	3.61	4.26	2.71	4.2	3.69	3.24	3.19	3.19	3.67	1.64	3.85	2.82	4.35	1.97	4.15	4.17	3.42	3.9	2.9	4.08
Female	3.3	3.65	4.23	2.52	4.23	3.73	3.2	3.09	2.94	3.82	1.63	3.75	2.66	4.28	2.02	4.12	4.3	3.4	3.8	2.93	4.07
Non-binary	3.27	3.5	4.09	2.45	4.09	3.54	2.91	2.36	2.91	3.54	1.43	3.54	2.36	4.27	1.91	4	4.36	3.27	3.54	2.91	3.82
Other	2.67	2.83	3.83	2.6	3.83	4.2	3.2	2.4	2.6	2.4	2	3.83	2.8	3.5	1.75	3.5	3.33	2.67	3	2.67	3.5
Eugene	2.8	3.44	3.82	2.31	3.84	3.62	2.7	2.89	2.53	3.62	1.64	3.54	2.33	4.29	1.92	3.91	3.98	3.16	3.82	2.51	3.85
Non-Eugene	3.37	3.65	4.29	2.61	4.27	3.73	3.28	3.12	3.08	3.77	1.64	3.81	2.76	4.29	2.01	4.14	4.3	3.43	3.81	2.98	4.08
Female Eugene	2.84	3.38	3.95	2.29	3.81	3.65	2.56	2.73	2.49	3.67	1.68	3.49	2.26	4.43	1.91	3.89	4.05	3.22	3.78	2.57	3.95
Fem non-Eugene	3.4	3.69	4.27	2.55	4.3	3.74	3.29	3.15	3.01	3.84	1.62	3.79	2.72	4.26	2.04	4.15	4.34	3.43	3.81	2.99	4.08
Male Eugene	2.75	3.67	3.42	2.42	4.17	3.5	3	3.64	2.67	3.92	1.55	3.67	2.55	4.08	2.09	4.17	3.83	3.17	4	2.25	3.75
Male non-Eugene	3.32	3.6	4.4	2.74	4.2	3.71	3.27	3.15	3.25	3.64	1.69	3.87	2.85	4.38	1.95	4.15	4.21	3.45	3.88	2.97	4.11
18-24	3.1	3.6	4.38	2.5	4.25	3.65	3.18	3.1	2.85	3.53	1.44	3.85	2.59	4	1.89	4.03	4.43	3.3	3.83	2.7	4.2
25-34	3.26	3.53	4.23	2.46	4.28	3.66	3.2	3	3.08	3.81	1.65	3.7	2.62	4.26	2.02	4.06	4.34	3.27	3.79	2.97	3.99
35-44	3.33	3.76	4.28	2.73	4.24	3.77	3.05	3.18	3	3.72	1.63	3.68	2.83	4.36	2	4.23	4.02	3.55	3.85	2.92	4.09
45-54	3.48	3.66	4.25	2.56	4.17	3.79	3.42	3.3	3.2	3.82	1.78	3.94	2.69	4.42	1.93	4.04	4.25	3.47	3.81	2.83	4.13
55-64	3.34	3.69	3.97	2.75	3.91	3.94	3.31	3.25	2.69	3.81	1.83	3.94	2.93	4.41	2.31	4.38	4.16	3.56	3.81	3.13	4.13
65+	3.3	3.8	3.9	3	3.67	3.5	3.3	2.88	2.56	3.4	1.25	4.2	3.11	4.3	1.5	4	4.22	3.6	3.9	2.67	3.7
Overall	3.29	3.62	4.23	2.57	4.21	3.72	3.2	3.09	3.01	3.75	1.64	3.77	2.7	4.29	2	4.11	4.25	3.39	3.81	2.92	4.05

Table A.1: Image Ratings by Group

Raw Heat Maps

Figure A.1: Q4 Negative (top) and Positive (bottom) Heat Maps

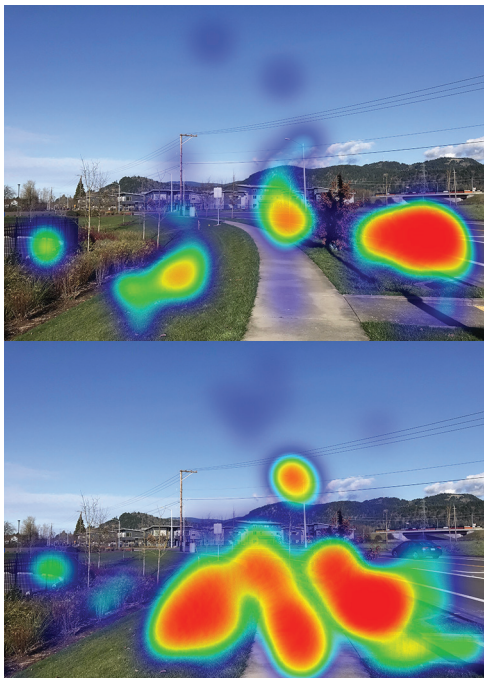


Figure A.2: Q5 Negative (top) and Positive (bottom) Heat Maps

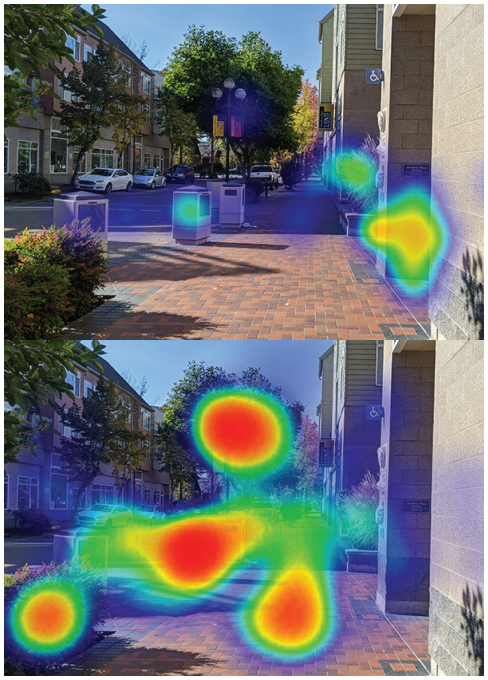


Figure A.3: Q6 Negative (top) and Positive (bottom) Heat Maps

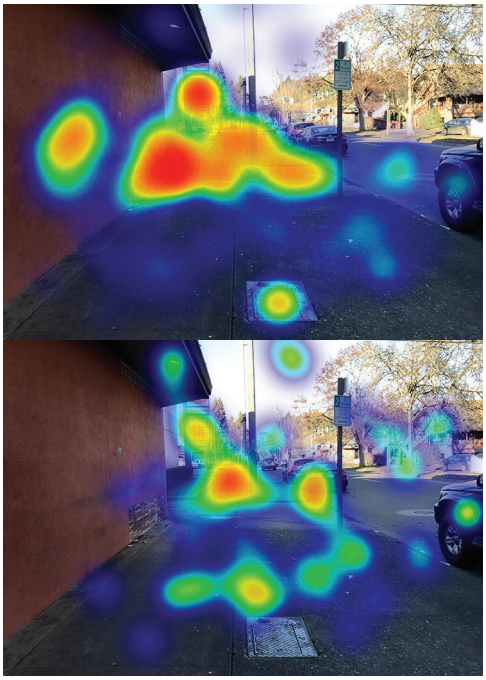


Figure A.4: Q7 Negative (top) and Positive (bottom) Heat Maps

Figure A.5: Q9 Negative (top) and Positive (bottom) Heat Maps

Figure A.6: Q10 Negative (top) and Positive (bottom) Heat Maps

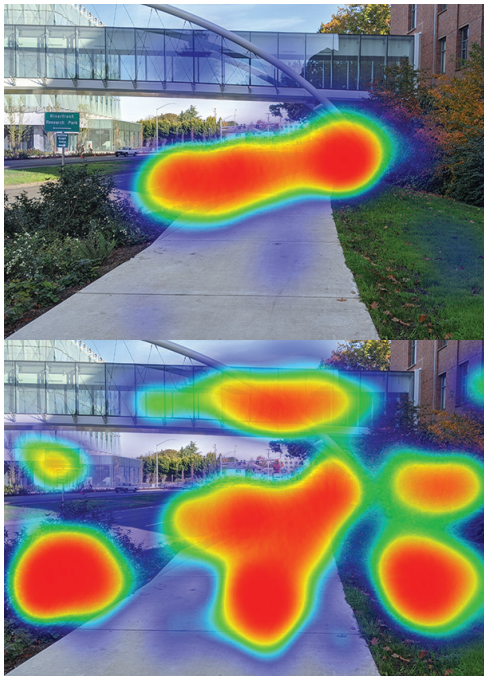


Figure A.7: Q11 Negative (top) and Positive (bottom) Heat Maps

Figure A.8: Q12 Negative (top) and Positive (bottom) Heat Maps

Figure A.9: Q13 Negative (top) and Positive (bottom) Heat Maps

Figure A.10: Q14 Negative (top) and Positive (bottom) Heat Maps

Figure A.11: Q15 Negative (top) and Positive (bottom) Heat Maps

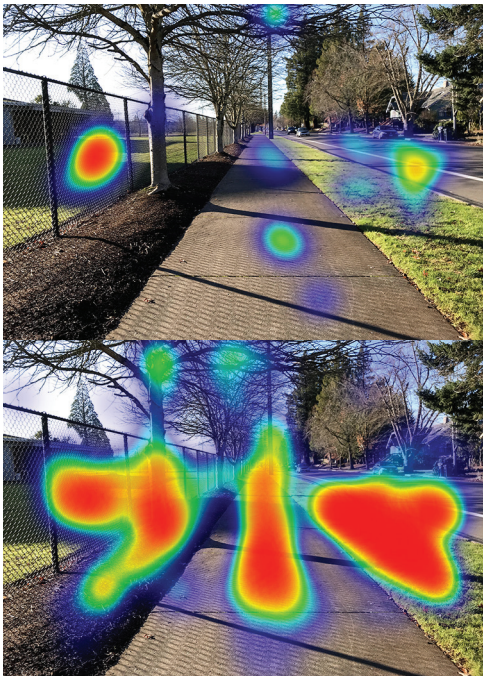


Figure A.12: Q16 Negative (top) and Positive (bottom) Heat Maps

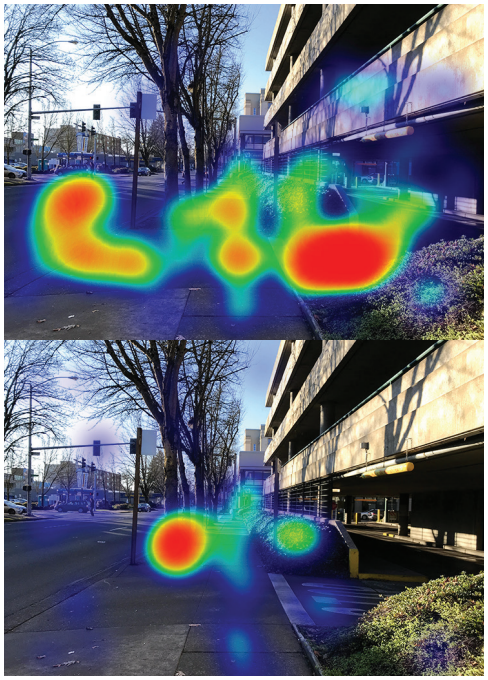


Figure A.13: Q17 Negative (top) and Positive (bottom) Heat Maps

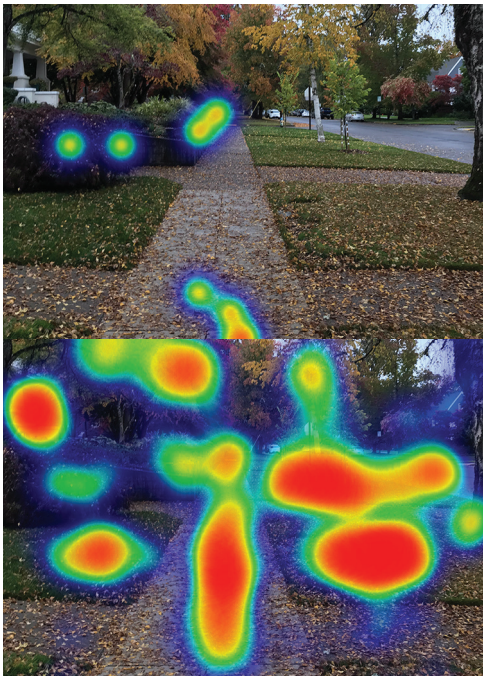


Figure A.14: Q19 Negative (top) and Positive (bottom) Heat Maps

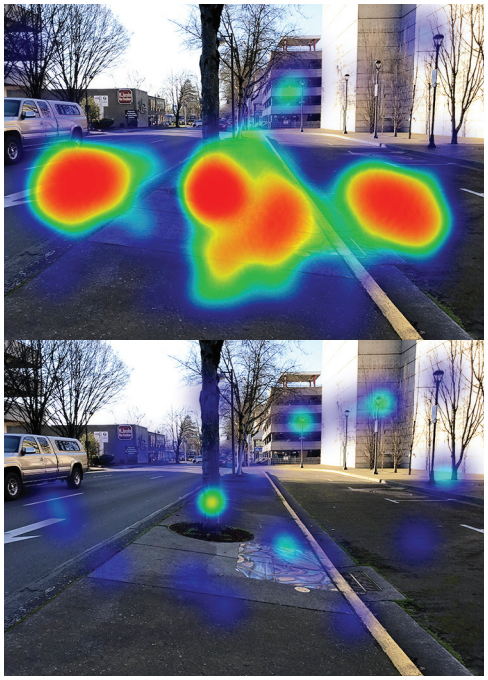


Figure A.15: Q20 Negative (top) and Positive (bottom) Heat Maps

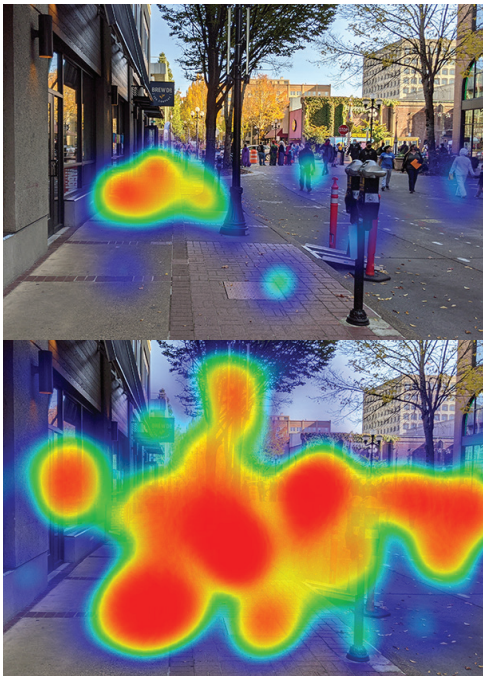


Figure A.16: Q21 Negative (top) and Positive (bottom) Heat Maps

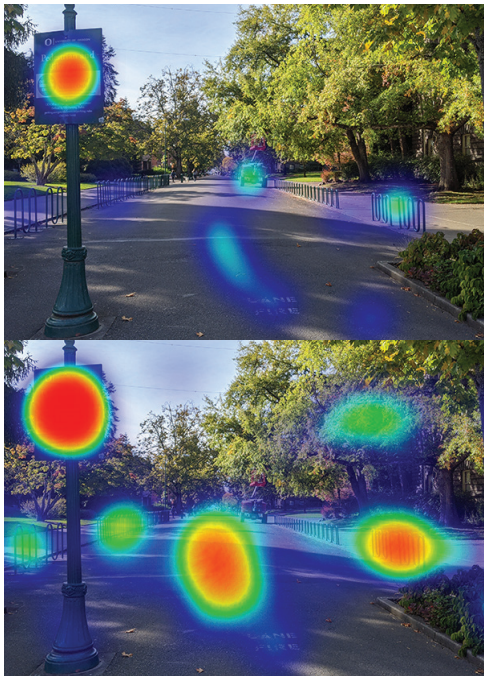


Figure A.17: Q22 Negative (top) and Positive (bottom) Heat Maps

Figure A.18: Q23 Negative (top) and Positive (bottom) Heat Maps

Figure A.19: Q24 Negative (top) and Positive (bottom) Heat Maps

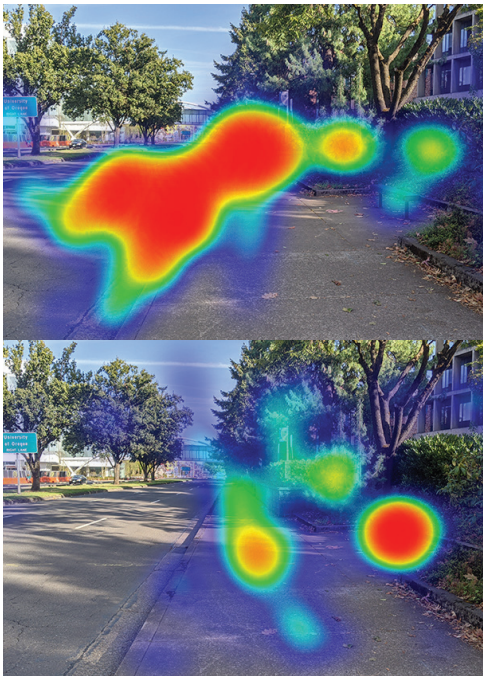


Figure A.20: Q27 Negative (top) and Positive (bottom) Heat Maps

Figure A.21: Q28 Negative (top) and Positive (bottom) Heat Maps

Appendix B: References

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