Understanding pedestrian decision-making during the COVID-19 pandemic

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Coronavirus Disease 2019 (COVID-19) caused by the SARS-CoV-2 virus became a worldwide global emergency in January 2020 and a worldwide pandemic in March 2020. COVID-19 is a highly contagious respiratory illness that primarily affects the lungs and, in some extreme cases, multiple organs, permanent organ damage and even death. The COVID-19 pandemic, and one of its primary mitigation measures, social distancing, has presented a change in the navigation of public walking spaces. In addition, measures have been put in place to reduce exposure to the disease. Generally, these efforts included recommendations to wear face masks if social distancing cannot be maintained, and at times the closure of schools, offices, businesses, and other non-essential establishments. As a result of restrictions and to encourage the maintenance of mental and physical health, public health officials have encouraged activities, such as walking outside, while maintaining a physical distance of two metres from others.

Despite a large amount of research conducted on public health aspects of COVID-19, very little has been focused on the impact on pedestrians and potential changes in behaviour due to COVID-19 related recommendations for social distancing. Moreover, little research has been done on how pedestrian mental models generally develop. A mixed-method study, employing a survey and semi-structured interviews, was conducted to explore the development of pedestrian mental models within the context of following social distancing measures. The objective of the thesis research study was to discover any new walking rules and mental models that adult pedestrians within the Waterloo Region of Ontario, Canada, are using as they navigate in outdoor public spaces, with social distancing measures in place.

The research study was conducted in two phases: Phase I (survey) and II (semi-structured interview), with the results of Phase I informing the direction of Phase II. The emerging mental models, rules, impacts, and changes experienced by adult pedestrians in the Waterloo Region are presented. New rules that pedestrians are using can be categorized into navigating public spaces, crowded places, and locations with strangers. The results of the survey and emerging rules suggest that pedestrians are experiencing a higher level of risk awareness when walking outdoors.

The results of this study indicate that adult pedestrians are now adjusting their walking habits and rules when walking in outdoor, public spaces in response to COVID-19-related social distancing measures. Based on reported actions to be taken for walking scenarios and emerging rules, pedestrians dynamically consider risk to self and risk to others when walking in public areas. Infrastructure was also noted as an important aspect of determining what action to take by pedestrians to create or maintain social distance. Recommendations related to changes in infrastructure, including wider sidewalks and pedestrian-friendly streets, and strategies for public education are discussed.

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Dedication

This thesis is dedicated to the memory of my parents, George, and Patricia Greenslade, who both always encouraged and supported me. Thank you.

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Chapter 1

Introduction

1.1 Motivation

From an early age, pedestrians are taught the general rules for walking in the presence of traffic. For example, "look both ways before crossing the street;" and "walk facing traffic if there are no sidewalks." The COVID-19 pandemic presents a unique opportunity to explore how new pedestrian "rules" are emerging under challenging conditions and where formal education is yet to be created and tested for efficacy. Knowledge of the current 'rules' followed by pedestrians better allows for appropriate changes and adjustments to be made in response to the new rules being created, as well as helping pedestrians in their navigation with these new rules.

The research method conducted in this thesis is generative research, which is an early-stage research strategy done to develop an understanding of users and the possible problems they face to produce new solutions (B. M. Hanington, 2007; Young, 2008). Generative research, also known as exploratory research, is "… a methodological approach that is primarily concerned with discovery and with generating or building theory." (Davies, 2011). Through this study, information was obtained from pedestrians regarding their behaviours, thoughts, and feelings around situations with pandemic-related social distancing measures. The self-reports were used to identify new and emerging mental models. Data collection was restricted to the Waterloo Region, Ontario, Canada, as this allowed the researcher, who is a resident of the region, to interpret the results in the context of the regional restrictions in place along with the infrastructure and public education available at the time of the study. Restricting data collection to a specific region aided comparison of results from Phase I (survey) and Phase II (interviews) based on a similar geographic location and regional rules in place.

1.2 Impact of COVID-19 within Waterloo Region

As of December 20, 2020, Waterloo Region had recorded 5,007 COVID-19 cases and 142 related deaths ("Waterloo Region COVID-19 summary," 2020). In response to the impact that COVID-19 was having within Waterloo Region, authorities began implementing social distancing measures and restrictions in March 2020 as a preventative measure to slow the spread of COVID-19 (CBC, 2020). As understanding increased for COVID-19 is transmitted, it became clear that wearing masks would

be useful to slow the spread of COVID-19. On July 13, 2020, a mandatory mask by-law came into effect that required wearing a face covering while indoors in a public space and while on public transit. At the time of the writing of this thesis, the by-law has been extended until May 31, 2021, and could be extended further (T. R. M. of Waterloo, 2020). It is worth understanding the impacts of pandemic-related by-laws on behavioural changes including changes to the outdoor walking habits of adult pedestrians based on social distancing measures.

Given the extended time frame for the Waterloo Region pandemic by-laws relating to mandatory masks and social distancing, it is fitting to understand how pedestrians may be modifying how they navigate in public outdoor spaces. It is anticipated that this research will be useful in case of future similar pandemics that require social distancing as a measure of containment and reduction in exposure. In addition to examining the impact of social distancing restrictions, a mixed-method research approach was 'piloted' for identifying pedestrian mental models using a survey and semi-structured interviews. The mixed-method approach extends the more typical interview-based approach used for eliciting mental models (Young, 2008). As important, using a mental model approach extends understanding of pedestrian rules that are developing for social distancing (e.g., if another pedestrian approaching, step off path if safe to do so).

1.3 Research Objectives

Pedestrian behaviour changes due to COVID-19 context are of great interest. This study explores how pedestrians, in a region with social-distancing by-laws in place, assess and negotiate social distancing gap acceptance with other pedestrians while walking in public spaces (e.g., sidewalks, pedestrian paths, parks) where physical social distance indicators are likely to be infrequent or absent (e.g., painted pavement icons representing physical spacing for 6 feet gaps). Understanding how pedestrians make decisions about social distance gap acceptance is a fundamental step needed for identifying appropriate gap acceptance strategies, and for setting actionable guidelines for public education and designing physical countermeasures for walking environments.

To summarize, the overall objectives of this study are twofold:

- Develop a mixed-methods approach for identifying mental models and emerging rules used by pedestrians to maintain social-distancing under pandemic conditions; and

- Identify common social distancing pedestrian situations that could benefit from educational campaigns (e.g., information to guide decision-making when encountering other pedestrians), or designed countermeasures (e.g., changes to pedestrian infrastructure to support pedestrian traffic when stepping into the roadway is not an option).

1.4 Research Approach and Contributions

This study is comprised of two phases. Phase 1 uses a customized questionnaire to remotely survey adult pedestrians about their outdoor walking behaviours prior to the Covid-19 pandemic and during the Covid-19 pandemic. Phase II adapts a generative research approach common in user experience research, which uses semi-structured interviews to identify and analyze mental models of human decision-makers, in this case, pedestrians (Young, 2008; Zhang, 2012, 2013; Zhu & Shi, 2015).

Historically, the use of survey instruments to collect general information about pedestrian behaviours is common practice (Deb et al., 2017; Granié, Pannetier, & Guého, 2013; McIlroy et al., 2019); however, surveys are limited in their ability to probe the actual decision-making steps that a pedestrian might consider under novel circumstances. Formal approaches to capturing, diagramming, and analyzing mental models may start with surveys to understand general behaviours. Semi-structured interviews, which can be done remotely, are better suited for an in-depth understanding of mental models held by the individual as they "think through" appropriate courses of action. Sets of mental models can then be further analyzed to identify effective and ineffective strategies used by types of pedestrians (e.g., frequent walkers; infrequent walkers; persons that walk for pleasure; pedestrians that walk to work or school; pedestrians who walk for transit).

As a novel opportunistic study, this research contributes an introductory look at how pedestrians are adapting to ongoing changes because of the COVID-19 pandemic. The work has implications for planning and organization surrounding pedestrians for future epidemics as well. The primary contribution lies in understanding how adult pedestrians are starting to form new mental models for maintaining social distancing practices while walking in public spaces.

1.5 Overview of Thesis

The thesis is structured as follows:

Chapter 1: Introduction to the thesis research study. Motivation, research approach and proposed contribution

Chapter 2: Background on pedestrian behaviours and application for social distancing.

Chapter 3: Phase I: Survey of adult pedestrian self-reports on social distancing strategies

Chapter 4: Phase I: Survey Insights on Social Distancing (Results and Discussion)

Chapter 5: Phase II: Semi-structured interviews for uncovering social distancing strategies

Chapter 6: Phase II: Emerging mental models for pedestrian social distancing.

Chapter 7: Applications and Limitations of Pedestrian Mental Models

Chapter 8: Conclusion and Recommendations

Chapter 2

Background for Pedestrians During COVID-19 Pandemic

2.1 Coronavirus Disease 19 (COVID-19)

In December 2019, the first case of the novel coronavirus disease was discovered in Wuhan, China ((WHO), 2020b). Coronavirus Disease 19 (COVID-19) is caused by the SARS-CoV-2 virus (Zhou et al., 2020). This disease would become a worldwide global emergency on January 30, 2020, and on March 11, 2020, it would be declared a global pandemic and still is up to the writing of this thesis ((WHO), 2020a). COVID-19 is a highly contagious respiratory illness that primarily affects the lungs and, in some extreme cases, multiple organs, permanent organ damage and even death (Guzik et al., 2020). Although there has been evidence of persons with comorbidities and of an advanced age being the highest risk, there have also been cases of young and healthy individuals becoming victims of this disease (Guzik et al., 2020). As a result of the serious nature of COVID-19, social distancing has quickly become a regular aspect of everyday life.

2.2 Social Distancing

Given the novel and highly contagious nature of COVID-19, the medicinal treatments available are minimal. No vaccine was available to the general Canadian public until December 9, 2020, when the Pfizer vaccine for COVID-19 received approval from Health Canada (Aiello, 2020). To slow the spread of COVID-19 and reduce the strain on public health systems, various methods of prevention were suggested by the World Health Organization (WHO) as well as local and provincial health officials. Different countries and jurisdictions have attempted a variety of measures for reducing spread, from very strict movement control and stay-at-home measures in China to travel restrictions, gym closures, school closures, office closures, closure of non-essential businesses and guidelines to only go out for essential reasons and guidelines to not be within six (6) feet or two (2) metres of others outside of your own household without some form of personal protective equipment (PPE), i.e., masks covering nose and mouth (Kraemer et al., 2020).

A common method used to mitigate COVID-19 transmission is that of social distancing. Social distancing can be defined as the decrease or limited occurrence of physical interactions of people, particularly those who do not live in the same household (De Vos, 2020). Social distancing, also referred to as physical distancing, allows for the reduction in the spread of disease. Social distancing is

not a new concept or strategy used in the prevention of the spread of infectious diseases (Rashid et al., 2015). Social distancing and quarantine measures are not without drawbacks, including effects on mental and physical health and economic circumstances such as an increase in stress, boredom, anger, feelings of loneliness and inadequate access to supplies (Brooks et al., 2020).

Given the possible negative consequences that may be realized because of being at home more, it has been recommended that persons use physical activity to combat some of these negative feelings as well, to improve physical health, improve overall wellbeing (Lavie, Ozemek, Carbone, Katzmarzyk, & Blair, 2019), and as a preventative strategy to combat COVID-19's impact if contracted (Alkhatib, 2020). Faced with these new social distancing measures, pedestrians must now learn to safely navigate in public while maintaining appropriate distances. Identifying mental models can be used as a way of understanding the steps persons go through as they undertake specific processes, such as social distancing.

2.3 Pedestrians and Mental Models

Mental models are based on previous experiences in similar situations, in which a person has a mental picture or "small-scale models" of what they are anticipating and the appropriate reactions to be taken (Craik, 1943). "They [mental models] enable individuals to make inferences and predictions, to understand phenomena, to decide what action to take and to control its execution, and, above all, to experience events by proxy." (Johnson-Laird, 1983)**.** Mental models can also be defined as the observed behavioural patterns of individuals as they negotiate the use of a complex system based on previous knowledge of the same or similar system (Young, 2008; Zhang, 2013). According to Indi Young (2008), "It [a visualization of a mental model] is an affinity diagram for user behaviour." In other words, mental models are used to characterize the observed or self-reported behavioural patterns of individuals; and those individual mental models can be analyzed for common mental models or rules of behaviours experienced by a group of people. This allows researchers to have empathy and really envision what a user is experiencing. This research explores the mental models of pedestrians as they navigate urban environments under conditions of imposed social distancing.

The main method used to formulate the mental model in this study is heavily influenced by the method described by Indi Young (2008) in her book *Mental Models Aligning Design Strategy with Human*

Behaviour. Young's (2008) book and method focus on mental models from a business and industry standpoint; however, as mentioned in the book, mental models can be applied to any industry, situation or circumstance that requires understanding how its users make decisions as a method of improving or introducing products or processes. These applications range from understanding information search techniques (Zhang, 2007), end-user understanding of complex systems (Lin et al., 2012), and comparing the mental models of different groups (Gilbert & Rogers, 1999). As it relates to this study, mental models will be used to understand pedestrian decision-making process while practicing social distancing under COVID-19 pandemic conditions. Ultimately, a goal is to make recommendations to improve the current and future experiences faced by Canadian pedestrians during pandemics that require social distancing.

2.4 Pedestrian Decision-Making

The pedestrian walking process can, at times, be viewed as a simple, mundane task that requires no extra thought, which is not accurate. Walking, especially near traffic, is a complex process involving multi-step information processing including sensory processing, perception, decision-making, memory and cognition, attention, situation awareness and response selection and execution (Wickens, Hollands, Banbury, & Parasuraman, 2013). A typical pedestrian event, such waiting for a gap in traffic to cross the street, is made up of multiple information processing steps. With social distancing measures added to the experience, pedestrians are faced with more to keep in mind.

A decision of what to do in a new situation is made by taking a combination of all the information available from past experiences and environmental cues (Wickens et al., 2013). Decision-making around novel situations, like learning how to maintain social distancing, is an evolving process as multiple concepts come together in working memory. Working memory is a real-time processor of these information sources, and it is constantly being updated depending on where the pedestrian chooses to allocate their attentional resources (Baddeley, 2018).

Pedestrians must now update their decision-making strategies to account for changes in the abovementioned processes while navigating public spaces. In addition, it is expected that the emerging mental models discovered, along with the new rules that pedestrians are utilizing, will contribute to the broader discussion regarding pedestrians navigating with other pedestrians.

2.5 Pedestrians in Urban Environments

Of particular interest to this research study are the urban environments in which pedestrians frequent within the Waterloo Region. For this thesis study, an urban environment is "the area surrounding a city… developed, meaning there is a density of human structures such as houses, commercial buildings, roads, bridges, and railways."(Geographic, 2021). Areas of focus in this study include downtown locations, suburban areas, and local parks, as these are likely to be of interest to stakeholders (i.e., residents of Waterloo Region and policymakers) as they plan appropriate infrastructure measures within the region with a focus on spaces that work for the community, including pedestrians.

Programs focused on pedestrians have been initiated in other jurisdictions, including 'yongeTOmorrow' in Toronto, Ontario, Canada ("yongeTOmorrow," 2020) and 'Streetspace for London' in London, England (LONDON, 2020). Both campaigns focus strongly on improving streets for pedestrians. The 'yongeTOmorrow' campaign is a project that started prior to COVID-19 with a focus on making Yonge Street in Toronto a more pedestrian-friendly, complete street. A 'complete street' is "…a street that works for motorists, for bus riders, for bicyclists, and for pedestrians, including people with disabilities." (McCann, 2005). This initiative, which started in Spring 2018, is focused on transforming the popular street into one that is more pedestrian-focused, one that can support the continuous increase in pedestrians and cyclists on the street and the addition of more green space. More recently, 'Streetspace for London' was created in response to the COVID-19 pandemic with a multi-faceted approach focused on creating spaces to make social distancing easier, reduce reliance on motorized vehicles and encourage citizens and tourists to be more active. Temporary bike lanes, implementation of zones for walking, transit and cycling only, widening of sidewalks and adjustments at pedestrian crossings that allow for continuous movement when vehicles are not present are some of the measures that have been implemented temporarily in response to this approach.

Within the Region of Waterloo, there have been recent initiatives, including the Active Transportation Campaign which focuses on making streets more pedestrian-friendly for all abilities, enabling more environmentally friendly means of transportation, and encouraging residents to be more active ("Active Transportation," 2020). Changes that have these goals in mind not only benefit pedestrians during times when social distancing is necessary but also during other times by contributing to an improvement in the environment, quality of life and health. The results of this thesis research study may benefit

initiatives such as these by having feedback and insights on lived experiences collected directly from pedestrians.

During COVID-19, changes have been temporarily made to improve pedestrian experiences and accessibility. These included the temporary conversion of two streets in the Waterloo Region, Belmont Village in Kitchener (Thomson, 2020) and Willis Way in Waterloo (Nielsen, 2020), temporary bike lanes (Brown, 2020; Region of Waterloo, 2020), traffic calming measures in residential areas, restricting access to local traffic only (Silva, 2020). These changes, made in response to COVID-19, allowed for the expansion of the roadway to allow more access for pedestrians, cyclists, and other non-motorized vehicles to utilize. It also encouraged residents of the region to increase time spent outdoors as well as to improve access to nearby businesses and overall additional space for easier social distancing. The examples show the possibilities for improvement of the current pedestrian experience with social distancing due to COVID-19, as well as the types of programs that can benefit pedestrians even after pandemic conditions have ceased.

2.6 Methods for Studying Pedestrians Under Pandemic Conditions

During the current COVID-19 pandemic, conducting pedestrian research studies, particularly one that is focused on COVID-19 social distancing measures, is a challenge as typical research methods are not available or suitable based on safety restrictions. Commonly used methods of researching pedestrian behaviour include surveys, observation and lab-based experiments (Feng, Duives, Daamen, & Hoogendoorn, 2021). At the time of data collection for this thesis study, in-person lab-based experiments were not feasible due to regional restrictions to limit the spread of COVID-19 (CBC, 2020), and these restrictions are still in place up to the time of the writing of this thesis report.

2.6.1 Observation

One of the most common methods of obtaining data regarding pedestrians' behaviours would be to observe them in real-time as they navigate social distancing situations. This would afford the researcher the ability to not only gather data quickly about multiple pedestrians, but it would also prevent any memory bias present in self-reports from pedestrians by observing them in a natural setting and avoid the phenomenon of pedestrians saying what they would do ideally instead of what they would really

do. Due to pandemic conditions, which saw social distancing measures in place along with instructions to remain at home except for essential reasons, direct observation was not suitable for this thesis research study.

Conducting observational research can be a complex task because the researcher has no control over the situation, and it would be difficult to ensure that each pedestrian observed would be facing the same conditions with each observation. In addition, the use of observation, without interfering with the persons being observed, means that analysis of the data is up to the interpretation of the researcher, which can not only lend itself to biases but also lacks the element of explanations or validation from the pedestrians themselves which would allow for the researcher to have an understanding as to why a certain action is taken. In the case of this study, to uncover new and emerging mental models, requires getting deeper insights from pedestrians, and not just surface-level observation Ideally, for an observational method to work for this study observations would need to be made with individuals of the same or similar background toto those participating in the surveys and interviews.

2.6.2 Surveys

Surveys enable researchers to collect lots of data in a short period of time, along with a structured distribution method. The nature of surveys typically allows respondents to participate at their own convenience.

The types of questions included in surveys also contribute to the ease with which data is analyzed. Closed-ended questions allow for ease of quantitative data analysis and the ability to compare results more accurately with these methods. Web surveys also allow for a level of anonymity being provided to respondents, and this can be both an advantage and limitation of this method. It is advantageous for respondents to freely answer questions without fear of judgement or other negative feelings when their identity is unknown. This same anonymity can mean that some respondents may not take the survey seriously or choose to intentionally give incorrect or false responses to questions, which would then skew the reliability of the data received. Furthermore, questions or misunderstandings about questions from respondents cannot be addressed while a survey is being taken, especially for a web survey this

can lead to dropouts, skipped questions or responses that do not accurately answer what is being asked of them.

Distribution format and language can lead to an over or under-sampling of certain categories of respondents (e.g., younger adults), leading to some categories having more of a voice compared to those that were not sufficiently represented or unable to access the online survey. Surveys also require a certain level of time commitment from respondents depending on the length of the survey, which can lead to non-response, incomplete questions, or inaccurate responses if the respondent is hurrying to finish.

2.6.3 Thematic Analysis

Thematic analysis is a qualitative research analysis method used to analyze data for the presence of recurrent subject areas, themes, thoughts, or ideas that provides an insight into the understanding of the research topic being studied (Hawkins, 2017). Thematic analysis is not one method of analysis but encompasses a variety of methodologies and coding practices(Creswell, 2007; Saldaña, 2013). This variability is one of the core aspects and advantages of thematic analysis, which is useful in the application of different research theories and frameworks, working with qualitative data from an interview, focus groups, observations, and open-ended survey questions, among other qualitative methods (Braun & Clarke, 2006). Further, thematic analysis can be applied to a wide variety of research questions and is not isolated to any one domain (Guest, MacQueen, & Namey, 2014).

Nevertheless, a common criticism of thematic analysis is the very subjective nature of the analysis, which can be heavily biased by the interpretation of researchers themselves when compared to other research methods. It is also dependent on what researchers focus on within the data and the themes developed are dependent on these extractions. Two methods of combatting the subjective nature of thematic analysis are member checking/validation, which involves the presentation of the final research report or analysis being presented back to the group under investigation, and this group inspects the results for accuracy (Lewis-Beck, Bryman, & Futing Liao, 2012); and triangulation a concept introduced by sociologist Norman Denzin (Denzin, 2012), which uses multiple methods of data collection or analysis as a way of validating the accuracy of data collected (Braun & Clarke, 2019).

This can be in the form of multiple analysis methods, multiple researchers analyzing, or multiple sources from which data is collected (Flick, 2020).

There are three types of approaches that can be taken with thematic analysis. These include coding reliability (Saldaña, 2013) and codebook (Saldaña, 2013), which emphasize theme development in the early stages of analysis, and reflexive, which emphasizes theme development at the end of the analysis. An aspect of the flexibility of thematic analysis lies in the varying approaches a researcher can take to develop codes and, eventually, themes. A common code reliability approach used by seasoned researchers is a codebook. This is an updated book of codes used in a study and includes the code and examples of data that would signify the relevance of this code. A codebook is particularly useful when multiple researchers are working with the same project data, allowing for consistency between researchers and across the dataset (Saldaña, 2013). The reflexive approach is used in this thesis research study and is informed by the work of Braun & Clarke (Braun & Clarke, 2006). The reflexive approach is one in which the analysis benefits from being able to be conducted by one researcher, in an iterative manner, in contrast to the approach of codebook reliability in which a team of researchers are involved in a coding consensus process (Braun & Clarke, 2019).

The analysis approach taken is dependent on the data being examined. Reflexive thematic analysis can be conducted by following a six-step process influenced by the methodologies used by Braun & Clarke (2006) and Nowell, Norris, White, & Moules (2017). It is an approach commonly used for similar analyses in research studies (Freeman, Akhurst, Bannigan, & James, 2016; Jongenelis, Morley, Worrall, & Talati, 2020; Todd, Jones, & Lobban, 2011). The process outlined by Braun & Clark (2006) is summarized below.

Step 1: **Becoming familiar with data:** All data used for the analysis is collected and read thoroughly by the researcher to become familiar and comfortable with the data, and to allow for initial ideas about codes to be created.

Step 2: **Initial code creation:** The researcher goes through the data and pulls out codes, words, or short phrases that efficiently summarize the overall view of each statement.

Step 3: **Code revision and grouping**: The initial codes are grouped together by similarities. Code revision may be needed at this stage after going through all the data, even as codes are grouped together.

Step 4: **Categorization:** Grouped codes are further refined by the creation of categories that contain the essence of the codes within each group. Code revision may continue to occur. Themes may start to emerge, and the researcher begins to think about the story that the final themes will tell based on the research objective.

Step 5: **Theme emergence:** The created categories are examined, and connections are built. The themes generated contribute to the 'storytelling' of the data collected and answering the research question(s). Iteration and refinement, even going back to the coding stage, may be done after looking at all the data collected and realizing that a particular piece of information may not fit as initially determined.

Step 6: **Report Creation**: Occurs once all the themes and 'stories' being told with the data are extracted. The goal of the report is to connect the themes with the overall data analysis and present it. This report can take on multiple forms, either in text or visual format or a combination of both.

A coding process was done by the researcher, which included the examination of words and phrases to be attributed to specific codes. Given the novel nature of the study and reflexive approach used, the coding was continuously updated throughout the analytic process as further codes, categories, and themes emerged. This coding reference can be useful for future thematic analyses that focus on a topic that is like or builds on the results in this study (e.g., the study is repeated in another location) and as a basis for codebook creation.

Like other qualitative methods (e.g., interviews), the sample size required for thematic analysis is primarily dependent on the point of saturation, in which no new themes can be extracted from the data and having a large sample is not always necessary either (L. Given, 2012). Despite the simplicity of this concept, reaching saturation is not always possible in practice. To achieve the point of saturation, data should be collected and analyzed continuously until the researcher determines saturation has been achieved. This was not possible during this research study. The nature of this thesis research meant that the intended sample size was determined prior to receiving Office of Research Ethics approval for the

study. These challenges faced are not unlike those regularly seen in Ph.D. studies utilizing qualitative research methods, in which funding bodies require specific information about the proposed study prior to starting data collection (Mason, 2010). Given the circumstances, it cannot be definitively stated that the addition of data collected from other persons would elicit substantially different data. In addition, the use of a random sample, as in this study, may have made it difficult to determine if saturation was actually achieved (L. Given, 2012)

It must be mentioned that an effect of researcher bias on the results of thematic analysis is always possible, especially in the case of a novice researcher. For this study, the researcher, a resident of the Waterloo Region, designed and produced the research study and was also a part of the population under investigation. More specifically, unconscious bias (Byrne, 2017) may have occurred given the researcher's own beliefs about being a pedestrian or having preconceived notions about what pedestrians do, built on their own personal experiences during COVID-19. For this reason, it is important to be aware of the possible implications when conducting the analyses. It is important for the researcher(s) to continuously be aware of any inherent or unintentional biases that may be present throughout the research process and to try to avoid steering the research results based on predetermined information. This study may have benefitted from having multiple persons conducting the analysis. Notably, the study's undergraduate research assistant, who played a vital role in the early stages of the project, was no longer available during the analysis phase of the study due to academic commitments, so the analysis was conducted solely by the master's candidate.

Despite shortcomings mentioned, thematic analysis is still a useful and appropriate method for this research study given current circumstances and the focus of the research study. The flexibility of thematic analysis is appropriate for phenomenological studies (L. M. Given, 2012), such as t exploring the lived experiences of the residents of Waterloo Region as they follow social distancing measures. Thematic analysis was applied to the responses for the open-ended survey questions in Phase I to gain a deeper understanding or insight into closed-response answers. Given the specific nature of the question and responses given, thematic analysis was done to determine emerging themes of focus explaining why certain actions were being taken or not taken. An example of this is seen in the open-ended follow-up questions, which asked respondents to indicate the reason(s) for the change or lack of change in their daily walking frequencies.

Thematic analysis was used with the interview data in Phase II to extract the mental models and pedestrian rules. Given that this research study is an exploratory one, the use of thematic analysis grants the researcher the ability to achieve a stronger understanding of some of the themes surrounding the new mental models being built by pedestrians. The qualitative data was combed to pull out the emerging themes, particularly those surrounding the 'why' behind the new behaviours and rules being undertaken, and to highlight certain pain points or enjoyable aspects that stand out as common among adult pedestrians within the Waterloo Region. Insights discovered included feelings, opinions, frustrations, and the storytelling of real-life experiences. Compared to results of closed-ended questions without further understandings, thematic analysis with deeper insights adds a higher level of reliability and trustworthiness to recommendations.

2.7 Re-Cap of Gaps in Research

Numerous research studies have been conducted on the COVID-19 disease since March 2020. As of Oct. 12. 2020, when the term "COVID-19' is searched on the Scopus database, a total of 54,180 results were returned, and 40,034 when searched on the Web of Science database. Research surrounding COVID-19 has focused on understanding the disease itself (Benvenuto et al., 2020; Gwenzi, 2020), detection (Ismael & Engür, 2021; Sharifi et al., 2021), methods of treatment (Guzik et al., 2020; Marian, 2021) and preventative strategies (Anttiroiko, 2021; Ataguba & Ataguba, 2020)**.** When the term pedestrian was searched within "COVID-19" results, only 65 results were returned. Recommendations are made by public health authorities to remain physically active to maintain physical and mental health (World Health Organization, 2020). Noting the importance of social distancing in mitigating the spread of COVID-19, little to no research has been published that focuses on understanding how pedestrian decision-making might be impacted by social distancing measures at the time of writing this thesis.

Chapter 3

Phase I: Survey of Pedestrian Social Distancing Strategies

3.1 Survey Usage

"A Survey is a system for collecting information from or about people to describe, compare, or explain their knowledge, attitudes, and behaviour." (Fink, 2003). In this research study, the survey was used as an instrument to gather general walking behaviours and perspectives from pedestrians within the Waterloo Region. The researcher used the Phase I results to formulate semi-structured interview questions for Phase II. This chapter describes the questionnaire created for surveying self-reported data surrounding social distancing situations for adult pedestrians within the Waterloo Region. The survey design, inclusive of question selection and creation, will be presented along with the survey distribution methodology and respondents' demographics.

This study received ethics clearance (ORE # 42014) through the University of Waterloo Office of Research Ethics and was conducted as stated in the approved protocols (see Appendix A)

3.2 Survey Design

The researcher conducted a literature search utilizing the Transportation Research Board database (TRID), SCOPUS and Web of Science databases during April and May 2020 for suitable, validated questionnaires and surveys relating to pedestrian behaviour. Specifically, the literature search focused on finding validated surveys related to pedestrian mental models. This initial search was not successful, and the search was then expanded to include validated surveys about pedestrian behaviour in general. The subsequent search elicited several surveys that were focused on pedestrian behaviours (Deb et al., 2017; Granié et al., 2013; McIlroy et al., 2019). The lack of research instruments and previous literature on pedestrian mental models also pointed to a gap in the literature. The decision was made to modify the content of the pedestrian behaviour surveys by Deb et al.(2017), Granié et al.(2013) and McIlroy et al. (2019) by adding a focus on pedestrian behaviours with social distancing measures.

The questions for the survey questionnaire were created by extracting questions from three previously validated pedestrian behaviour survey questionnaires, namely "Development and validation of a questionnaire to assess pedestrian receptivity toward fully autonomous vehicles"(Deb et al., 2017);

"Vulnerable road users in low-, middle-, and high-income countries: Validation of a Pedestrian Behaviour Questionnaire" (McIlroy et al., 2019) and "Developing a self-reporting method to measure pedestrian behaviours at all ages" (Granié et al., 2013) Questions from Deb et al. (2017), Granié et al.(2013) and McIlroy et al. (2019) relating to general pedestrian behaviours were adapted and indicated that respondents would be answering the questions based on scenarios involving other pedestrians under social distancing guidelines (see Appendix B). The focus of the questionnaire introduced by Granié et al. (2013) was the validation of a self-reported pedestrian behaviour questionnaire suitable for pedestrians of all ages as a measurement of risk-taking behaviours. Similarly, Deb et al. (2017) used a shortened version of the pedestrian behaviour questionnaire validated by Granié et al. (2013) within their study, which focused on developing and validating a survey on pedestrian receptivity of autonomous vehicles within the United States. The focus of McIlroy et al. (2019) was to validate the shortened version of the pedestrian behaviour questionnaire (Deb et al., 2017) within non-North American countries (i.e., Bangladesh, China, Kenya, Thailand, UK, and Vietnam).

Although the aim of the aforementioned studies was not the same as this thesis research, their use and validation in the domain of pedestrian behaviour and within North America made them suitable for use with an adult pedestrian population in Canada. General pedestrian behaviour questions selected from the previously cited works for use within this thesis research study were those that focused on a pedestrian's walking behaviour when interacting with other pedestrians, questions regarding distractions while walking, questions surrounding pedestrians walking in prohibited locations. Questions that focused on interactions with motorized vehicles or their occupants were not selected as they did not fall within the scope of the current research study.

Better practices for survey creation are to validate the survey instrument (Ruel, Wagner, & Gillespie, 2018). Survey validation is done to ensure that questions asked are measuring what is intended for a specific audience along with survey reliability, which confirms that comparable results can be replicated consistently (Ruel et al., 2018). Survey validation involves the selection of items to be included in the survey, assessing face or content validity, pilot testing of questions, survey distribution to the target audience, an evaluation of the survey scales, evaluating the consistency and reliability of survey responses received, and determining the validity of the survey using statical measures. (Boateng, Neilands, Frongillo, Melgar-Quiñonez, & Young, 2018) Non-validated surveys, however, are still

useful in situations that do not require consistent measurements but instead are focused on gathering data from a specific population (Warner, Carlson, Crichlow, & Ross, 2018) and is also not unheard of when taking a first look at a specific research focus that has not been examined before (Quinton, Lazzarini, Boyle, Russell, & Armstrong, 2015). The purpose of the survey questionnaire in this research was to gather information from adult pedestrians within the Waterloo Region on their motivations and decision-making behaviours surrounding social distancing measures to inform the semi-structured phase of the research. The survey used in this study was not validated beyond face validity.

Face validity is "…the degree to which a measure is clearly and unambiguously tapping the construct it purports to assess… the "obviousness" of a test—the degree to which the purpose of the test is apparent to those taking it." (Lewis-Beck et al., 2012). When looking at the face or internal validity of the questionnaire used in this study, it can be considered valid given that the conclusions and results obtained align with the questions being asked. Examples of this validity can be observed in the following questions: 'How would you describe the areas where you do most of your walking?'; 'How often do you walk in a day currently, with social distancing?'; 'Why has the frequency of your walking remained the same, increased or decreased?'; 'What range best describes your daily walking time before social distancing (e.g., total time spent walking in a day)?' With this level of transparency and obviousness, it is expected that respondents would sufficiently comprehend the purpose of the questions being asked.

As a part of setting up suitable scenario questions for the survey, the researcher conducted a brainstorming session (Young, 2008) along with the undergraduate research assistant as a method of inserting aspects of a 'walk' that would need to be answered by pedestrians. This first involved coming up with any type of decision or action that a person could take prior to, during, or after a walk. The purpose of this was not to determine or produce all pedestrian actions but to find connections between actions and determine what questions they were answering. For example, a person will walk to the grocery store, and a question that this can answer would be "What is the purpose of your walking trip?" this method was adapted from one used by Indi Young (2008). This not only contributed to question development but was useful in getting into the mindset of a 'typical' pedestrian.

Tasks and actions that may be done by pedestrians were created and grouped together based on common characteristics. For example, actions that mentioned activities being done while walking (e.g., listening to music; talking on the phone) were in a group; actions that mentioned a reason for going on a walk were in another group). The brainstorming and task grouping strategy is loosely based on the "Task-Based Audience Segments" process outlined by Indi Young (2008). During this process, Young (2008) conducted a group brainstorming task that was used to determine audience segments that would be interviewed for the mental model creation process. The outcome of the brainstorming process utilized in this thesis research study differed in that the outcome of the task groupings was used to inform the categories of questions to be added to the Phase I questionnaire. This was done because the Phase I results would determine the sample of participants interviewed in Phase II of the study, allowing the researcher to produce a pool of activities to create a base 'model' to get started.

The grouping of pedestrian behaviours allowed for a preliminary 'model' of stages in a walking process to be created, which inspired some of the question categories to be used for the online survey to guide the organization and flow of questions (see Figure 1). The stages or basic steps outlined below need to be expanded to specify what pedestrians are doing when going through each step in the walking process. This step was slightly different from that used by Indi Young, in which the results of the brainstorming session determined which groups of individuals would be interviewed. Similarly, the brainstorming session for this thesis research study only involved the author and the undergraduate research assistant conducting the brainstorming. Figure 1 illustrates the overarching stages in the general walking process and the main categories for the survey questions that were formed after the brainstorming session.

Figure 1. Phases during a walking trip by a typical pedestrian.

3.3 Survey Questions

The final survey that is used can be seen in Appendix C. During the survey, respondents were asked questions relating to their experiences both prior to and during social distancing. Questions were asked in yes/no, Likert-type scale, open-ended and multiple-choice formats. These questions ranged from what you do or might do in general situations to how you might react in specific scenarios. As described in Section 3.1, the questions for the survey questionnaire were created by extracting questions from three previously validated pedestrian behaviour survey questionnaires (Deb et al., 2017; Granié et al., 2013; McIlroy et al., 2019). Some questions that were similar in nature to what we were looking for were altered to represent situations that would be more likely to be encountered by pedestrians following social distancing measures during the COVID-19 pandemic. For example, "I walk on cycling paths when I could walk on the sidewalk." was altered to "I walk on cycling paths when I could walk on the sidewalk, in order to avoid being too close to other pedestrians.; and "I take passageways forbidden to pedestrians to save time," was altered to "I take passageways (e.g., private property) forbidden to pedestrians to avoid meeting other pedestrians or cyclists on my walk. In addition, questions were added to gauge respondents' comfort levels, both with and without masks, as well as their comfort level being near other persons while in public. Finally, a section was added that focused on gaining insight into respondents' opinions on various social distancing visual aids and reminders in use in North America.

The question selection process, as outlined in section 3.1, for the questionnaire was done intentionally with the focus of gathering general information from pedestrians about their behaviours and thoughts, as well as demographic information about the respondents to determine the specific sample of persons to be interviewed in Phase II. In addition to standard demographic questions on age and gender, respondents were asked in which settings they most frequently walked (i.e., rural, suburban, downtown, parks/trails). Responses throughout the questionnaire took on various forms. Along with closed-ended responses, there were four opportunities for respondents to expand on their previous answers given via open-ended comment sections.

3.3.1 Demographics

Respondents were asked to indicate age range, gender, and the type of area in which they typically would walk in while in public. These were used as a basis to determine if they were any differences in

responses given based on age range and gender. In addition, gathering data on walking location allowed us to gain an understanding of where most of the walking takes place within the Waterloo Region of Ontario, Canada.

3.3.2 Comfort level approaching other pedestrians

Respondents were asked about their comfort level when approaching other pedestrians both prior to and during the COVID-19 pandemic. In addition, they were asked about comfort level when encountering pedestrians that were unknown to them (i.e., strangers) as well as those that were known to them (i.e., acquaintances). This allowed for statistical comparison to be done between time periods (i.e., pre-pandemic and during pandemic). Comparisons on comfort level could be made between approaching known versus unknown pedestrians. A five (5) item Likert-type scale was used, ranging from very uncomfortable to very comfortable. The use of a Likert-type scale enabled the researcher to capture a general impression of feelings of comfort respondents have about approaching others in public. The inclusion of a midpoint in the scale allowed for the capturing of neutrality in which respondents had no positive or negative feelings (Chyung, Roberts, Swanson, & Hankinson, 2017).

3.3.3 Mask wearing habits

Respondents were asked about their mask wearing habits, if any, prior to COVID-19, as well as their mask wearing habits during COVID-19, if any.

3.3.4 General walking habits

In this section, respondents were asked about their daily walking frequency, daily walking duration and general reason(s) for walking both prior to and during COVID-19 for all.

3.3.5 Walk planning

In this section, respondents were asked about their weekly walking frequency, time of day that they typically walk, walking distance and if they tend to walk in familiar areas.

3.3.6 Walk navigation

In this section, respondents were asked yes/no questions about ease of social distancing near crowds, with visual aids and mask wearing and social distancing. These were specific questions to gauge

pedestrians' general feelings towards these situations. Further insight on these subjects was provided within the survey and in follow-up interviews.

3.3.7 Comparison of walking behaviours prior to and during COVID-19

Respondents were given questions that asked them to indicate and compare actions taken while walking in public, both prior to and during COVID-19. Questions were asked regarding walking alone and while walking with one or more persons, if applicable. For these questions, a six (6) item Likert-type scale was used, ranging from very infrequently or never to very often or always. Using this scale allowed for direct comparisons of responses given between different combinations of time periods, genders, ages, and walking frequencies. A neutral midpoint was not included in this scale, forcing respondents to select a choice that was within the category of frequently or infrequently. It was expected that including an even number of scale items would increase the strength of the responses received (Brill, 2012); however, it is possible that the inclusion of a forced choice may have negatively impacted the responses of persons that have a neutral response to the statement and produce "biased data" (Chyung et al., 2017).

3.3.8 Walking Scenarios

Respondents were presented with ten scenarios of varying complexities, settings, and characters to gauge their responses to these situations. The scenarios were presented in the questionnaire as an image and text description. Each of the scenarios presented represented real scenarios that occurred within the Waterloo Region between March 2020 – May 2020. Scenarios were based on experiences and observations of the research team while social distancing measures were in place. The five (5) response options ranged from: continue on the current path, stop to let others pass, step off the path, cross to the other side, and other with space for further explanation given.

3.3.9 Countermeasure ranking

This section on countermeasures provided a straightforward way for respondents to indicate their opinion on the usefulness of several types of visual aids surrounding social distancing. Respondents ranked the images of countermeasures in use at the time of the survey within the Waterloo Region of Ontario, Canada, as well as those that are used in other jurisdictions for a similar purpose (e.g., a posted sign reminding pedestrians to maintain social distancing).

3.4 Pilot Testing

Prior to the commencement of the survey distribution, pilot testing was conducted with six respondents. The respondents were current residents of the Waterloo Region and familiar with its infrastructure and current social distancing measures in place. Respondents were three females, two males and one person who chose not to declare. All respondents were directly recruited by the researcher and undergraduate research assistant as they were found to be suitably representative of the desired sample (i.e., adult pedestrians within the Waterloo Region with unique demographic characteristics). They were all previously known by the research team. Three persons were in the 18-24 age range, one person in the 25-34 age range and one person in the 45-54 age range.

Respondents were instructed to complete the survey as directed and invited to give feedback on any aspect of the survey. This allowed for the clarification of various questions as well as to get a firsthand account of how respondents interpreted certain questions. (See Appendix C)

3.5 Survey Distribution

Due to provincial and municipal requirements to maintain social distancing, survey respondents were recruited through mailing lists and social media. The survey was distributed University of Waterloo mailing lists (Weekly Grad Student e-news; various Departmental undergraduate and graduate mailing lists), Reddit (r/Coronavirus; r/SampleSize; r/CanadaCoronavirus; r/kitchener; r/waterloo; r/cambridgeont) and a local Facebook community group (Kitchener/Waterloo this and that). This distribution method was used to collect data from a convenience sample of the Waterloo Region adult population. The use of this method of sampling made for quick and efficient data collection.

The anonymous online survey was hosted on the Qualtrics Online Surveys system. The survey opened for responses beginning July 10, 2020 and remained open until August 7, 2020.

Interested persons were invited to click the provided anonymous link to the survey. No identifying information was collected, and the responses were not identifiable. Before proceeding, respondents viewed information about the study as well as the contact information of the research team. Respondents were asked to verify their current location as being within the Waterloo Region of Ontario and to agree to the consent terms of the survey, and then complete the web survey. At the end of the

survey, respondents were invited to enter a gift card draw. They were also invited to demonstrate an interest in participating in phase two of the research study, a semi-structured remote interview, by submitting their contact information. The contact information collected was kept separate from survey responses, and no linkage between the two was created.

Chapter 4

Phase I: Survey Insights on Social Distancing

(Results and Discussion)

4.1 Phase I Results

This chapter presents an overview of Phase I survey responses, a discussion of the analysis methods utilized for both open closed and open-ended questions, as well as results obtained from the Phase I web survey. Further insights are given on responses to social distancing scenarios.

4.2 Respondents

A total of 332 residents and visitors within the Waterloo Region of Ontario, Canada, responded to the anonymized web survey hosted on Qualtrics. For the purposes of this thesis, the Region of Waterloo included the cities Kitchener, Waterloo and Cambridge and the townships of North Dumfries, Wellesley, Wilmot and Woolwich, Ontario. Before analysis commenced, the following entries were removed: responses that were completely blank; responses that did not come from persons currently in the Waterloo Region; responses in which the respondent did not proceed after giving consent. This left 252 completed responses in the dataset to be analyzed.

Respondents comprised a convenience sample consisting of 158 (62.7%) females, 87 (34.5%) males, 1 (0.4%) person who identified as other and 6 (2.4%) persons who chose not to declare their gender. The age range of respondents were as follows: 18-24 (60 persons); 25-34 (122 persons); 35-44 (41 persons); 45-54 (16 persons); 55-64 (9 persons); 65-74 (4 persons), with most respondents falling within the 25-34 (51%) age range. The median age in the Waterloo Region is 39.1, according to the 2016 census, which is lower than the Canadian average of 41 (Region of Waterloo, 2016), and this was demonstrated in the demographic distribution of respondents. Given this, the age ranges exhibited by respondents were as expected, with most respondents falling in the combined age range of 25-44.

The desired sample size for Phase I of the research study was 385 persons and this was determined based on the guidance of Taherdoost (2017) and Bartlett, Kotrlik & Higgins (2001) with the use of *Equation 1* for calculating survey sample sizes. In this calculation, n = calculated sample size; E (5) =

the margin of error that the researcher is willing to accept; z (1.96) = the z score associated with the selected confidence level of 95%; and p (50) = the estimated variance within the population which is suggested to be a safe estimate when the actual value is unknown in a population (Bartlett et al., 2001).

$$n = \frac{p\,(100 - p)z^2}{E^2} \qquad\qquad (1)$$

The desired sample size not being fully achieved is similar to instances in which researchers have reported lower response rates for web surveys compared to other methods, such as in-person, telephone, or mail-in surveys (Manfreda, Bosnjak, Berzelak, Haas, & Vehovar, 2008). Further, the metanalysis of 45 studies comparing web survey response rates to other methods "showed that on average, web surveys yield an 11% lower response rate compared to other modes." (Manfreda et al., 2008).

Having a lower response rate than desired also contributes to a reduced level of power, which equates to a lower probability the confidence interval contains results found within the general population (Sauro & Lewis, 2016). As with any study there is the possibility of having Type 1 or Type II errors occurring w so must interpret statistical results with caution. Type I errors occur when a significant result is found that does not exist (Litière, 2012). The probability of making a type I error is expressed via the significance level chosen. In this research study, a significance level of 95% was chosen, which corresponds to a 5% probability of making a Type I error. An increase in the significance level chosen reduces the chance of a Type I error occurring (e.g. a 99% significance rate would correspond to a 1% chance of a Type I error occurring), but it also increases the risk of a Type II error occurring (Litière, 2011). Furthermore, a confidence level increase without a change in sample size is associated with a lower power level (Sauro & Lewis, 2016). Increasing the sample size of Phase I may contribute to a higher probability of finding results that correspond to the adult pedestrian population within the Waterloo Region. Type II errors occur when a significant result exists, but our statistical test fails to reject the null hypothesis (Litière, 2011). Increasing the study sample size can be done to decrease the risk of a Type II error occurring, with the typical trade-off of increasing Type I errors. Therefore, an approach must be carried out that takes into account the representative nature of the sample along with sample size when attempting to control for both Type I and Type II errors. The sample obtained during Phase I appears to be reasonably representative of the demographic makeup of Waterloo Region.

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Notably, the high rate of younger and female respondents relates to the reported population of Waterloo Region based on its most recent 2016 census (Region of Waterloo, 2016).

Given the reasonable representativeness of the sample, the results can still be useful because it gives us a first look into the Waterloo Region adult pedestrian population responses to social distancing. For an exploratory study such as this, it is a first look into this specific problem space of adult pedestrians' navigation and dealing with social distancing measures during a pandemic. It is particularly insightful for scenarios in which the majority of respondents gave similar closed-ended responses as well as strongly supported themes in open-ended responses. Even results for which a few persons gave outlier responses are still of value in the overall understanding of pedestrians' experiences. Nevertheless, the researcher cautions the complete acceptance of these results and would suggest replicating the study with a targeted, representative sampling method. Future studies may benefit from the use of a stratified representative sampling strategy in which participants are randomly selected from "mutually exclusive groups within the population…strata" (Gideon, 2012). An example of this would be to divide the population into age groups (e.g., 18-24, 25-34, 35-44 etc.) and randomly selecting participants from each group that is proportionate to their presence in the target population.

4.3 Data Analysis of Closed-Ended Questions

Data were analyzed using IBM® SPSS® Statistics Standard GradPack 27 for Windows and Mac. Questions that were analyzed concentrated on those that allowed respondents to self-report and compare their walking behaviours prior to COVID-19 and during COVID-19. This was done to determine whether adult pedestrians within the Waterloo Region of Ontario reported changes in walking behaviours due to current social distancing measures. Chi-Square test of independence was used to determine the presence of a relationship between gender and caution behaviours, age and daily walking frequency, age, and daily walking distance. Wilcoxon Signed-Rank test was used to determine if changes were present between pre-COVID-19 and during-COVID-19 situation questions.

For the sample gathered, no significant differences were found between respondents based on gender or age ($p < 0.05$). It was found that most Phase I respondents indicated walking regularly during the pre-COVID-19 period (i.e., prior to social distancing measures being implemented), with only 13 respondents indicating a daily frequency of "never." This suggests that most respondents were already

walking daily prior to COVID-19. There may be other factors that would contribute to differences in walking behaviour that are more nuanced, such as working or living situations, personal preference, or transportation methods. In addition, the lack of gender or age differences suggests that recommendations given can be expected to be useful and appropriate across these categories.

4.4 Open-Ended Response Analysis

Respondents were given opportunities to include open-ended responses at several points throughout the survey. These were included immediately following: Health & Safety questions, walking frequency questions and comfort level around others. A thematic analysis, following a six-step process like the ones used by (Braun & Clarke, 2006; Nowell et al., 2017) and outlined in Section 2.6.3, was conducted to discover the emerging themes depicted in these survey responses. A total of 221 individual open-ended comments were received for the follow-up question asking respondents to comment on their walking frequency, and a total of 117 individual open-ended comments were left as responses in the social distancing scenarios**.**

The theme formation process entailed thoroughly going over the responses for the question being analyzed to become familiar with the data, and at the same start to get an idea of what kinds of codes would be used. For example, two responses to the walking-frequency open-ended question: "Working from home instead of the office" and "Working from home has caused me to take up walking as a form of exercise, but also as a tool to help me break-up my day and clear my head" are similar in their focus and would both be assigned a code of 'working from home' and the second response would also be assigned 'exercise' and 'break from work.' These codes are framed as direct responses to the question being asked.

The purpose of the codes is not to summarize the responses given but to pull out the subject or topic being given. When similar codes were combined to form categories, phrases were formulated that encapsulated the message further. For example, the code 'working from home' was placed into the category 'university/work switch to work from home.' Other codes in this category included 'university online now;' 'work online now,' which all include the main topic of no longer needing to go to a campus or office and instead work or school has become fully virtual.

Given knowledge of the questions prior to the open-ended comments, the survey questions did heavily influence the codes and eventual themes that were developed (See Appendix D). After all codes were placed into categories, the process of pulling out themes was done by looking at the created categories and combining them in different arrangements. This process saw themes begin to emerge as the combined categories were continuously compared to the question being asked and the overall focus of the research study, which was to gather insights from pedestrians on their walking habits during social distancing. It is important to note that this process was an iterative one and involved refining codes, categories, and themes, as necessary. This non-linear approach is standard in reflexive thematic analysis (Braun & Clarke, 2019) and allows the researcher(s) to adjust the analysis suitably as more information emerges from the analysis. The themes derived from thematic analysis are shown in Table 1.

Table 1. Themes derived from thematic analysis of survey open-ended questions.

Major Themes
• Reductions in the reasons for people to go outdoors lends itself to a reduction in the frequency of walking taking place
• Avoidance behaviours because of fear and avoiding the risk of exposure from being around others
• People are spending more time at home
• Going outdoors for physical and mental health reasons
• No change in daily routine and habits, so no change in frequency
• Difficult to find a reason or ability to go outdoors
• It is easy to go out for walks (increases)
• Only going out when necessary
• The weather would determine the desire to go out
• Walking more to avoid public transit

Minimal themes:

• Walking as a way to see others
• Major changes in work or living situation
• Drives mostly

Being an adult pedestrian within the Waterloo Region, with regular daily walking frequency both prior to and during COVID-19, may have had an impact not only on the choice and design of this research study but also inadvertently on the analysis of qualitative data throughout this study. An attempt was made to be as objective as possible throughout the research study by trying to focus only on using the data available or having discussions with the undergraduate research assistant and research supervisor. In addition, during both Phase 1 and II, pilot testing of the research instrument was conducted to indicate the presence of any leading questions being presented that could prime the respondent to give answers in a certain way. In future research studies, a more focused approach to reducing researcher bias should be followed. This would primarily include a process of self-reflection, known as reflexivity (Byrne,

2017), which would involve an ongoing process during the entire research process of being self-aware of the position of the researcher, relative to that of the population and topic being examined, along with any preconceived notions, beliefs, or assumptions that may impact the research design, data collection or data analysis.

Qualitative analysis of the data was done solely by the author of this study, namely the coding, categorization and theme creations based on the open-ended comments data in Phase I. As someone immersed in the research, the researcher was able to easily pick out relevant pieces of data to code and analyze. For a more balanced approach, it would be useful to have at least one other person to provide another perspective and compare analysis outcomes. Comparing the codes and themes generated from different researchers may add higher confidence and validation if similar outcomes are achieved or prompt a further look into aspects of data that generate contrasting results from the researchers.

4.5 Presentation of Insights

This section is comprised of the analysis of closed-ended responses given by respondents during the survey, and these insights will also include understandings based on the results of thematic analysis.

4.5.1 Health & Safety

For the Health & Safety questions, respondents were asked about their comfort levels approaching other pedestrians, both known and unknown, looking at pre-social distancing and during social distancing. Similarly, respondents were also asked about their mask wearing habits both prior to and during social distancing measures. Following this, respondents were given the opportunity to give an open-ended response and explain or add to their earlier response(s).

4.5.2 Approaching other pedestrians

Respondents reported being less comfortable approaching other pedestrians during the pandemic than prior, whether the other pedestrians were strangers [before (M = 11.20, SD = 7.68) versus during (M = 4.35, SD = 5.69), t (249) = 13.60, SE = .50, p < .001] or acquaintances [before (M = 16.46, SD = 5.43) versus during (M = 8.92, SD = 7.84), t (249) = 14.48, SE = .52, p <.001].

4.5.3 Mask wearing habits

When responding to questions regarding mask wearing habits (wearing a mask as a preference for health reasons) both before and during COVID-19, no respondents reported always wearing a mask before March 2020, 3.6% reported wearing a mask sometimes before March 2020, and 94.8% reported never wearing a mask in public prior to March 2020. In contrast, 48.4% of respondents reported always wearing a face mask in public after March 2020, 41.3% of respondents reported wearing a mask sometimes after March 2020 and 8.7% of respondents reported never wearing a face mask in public after March 2020. When looking at responses from respondents on or after July 13, 2020, when mask wearing in public became mandatory, 51% of respondents reported always wearing a face mask in public after March 2020, 40.6% of respondents reported wearing a mask sometimes after March 2020, and 6.5% of respondents reported never wearing a face mask in public after March 2020.

4.5.4 Walking Environments and Frequency

Respondents indicated the types of environments in which they commonly walked and were permitted to select all contexts that applied: 152 persons indicated doing most of their walking in downtown areas, 15 persons indicated walking in smaller towns, 143 persons indicated walking in suburban areas, four persons indicated walking in rural areas, and 147 persons indicated walking in parks or recreational trails. Respondents were asked to state their daily walking frequency prior to and during social distancing measures as well as a self-reported comparison of any walking frequency change between the two time periods. Wilcoxon Signed-Rank Test, which was run on both sets of data, indicated a significant decrease in daily walking frequency with the presence of social distancing measures during COVID-19 ($Z = -5.6$, $p < 0.001$). Figure 2 shows the comparisons in reported walking frequency pre-COVID-19 and during-COVID-19.
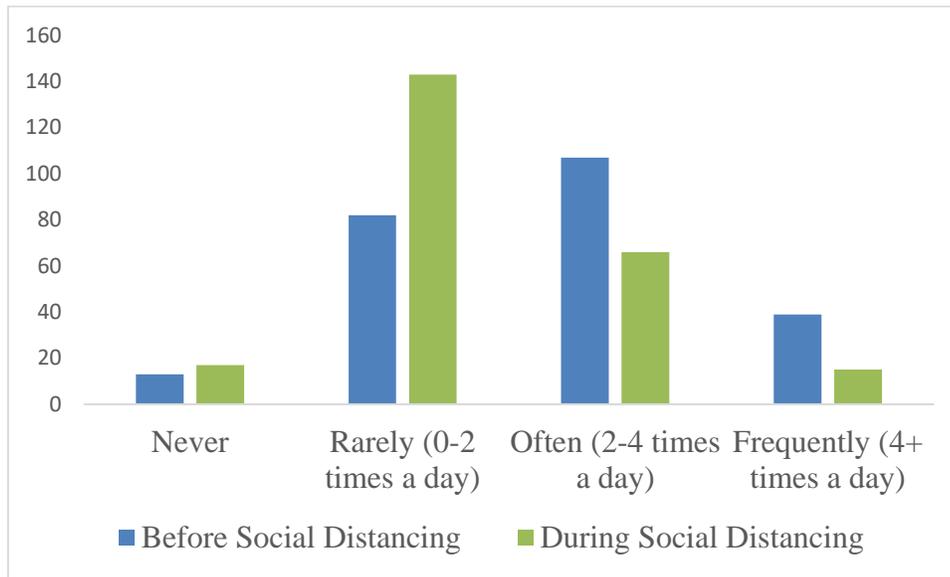
Figure 2. Daily Walking Frequency: Before Social Distancing & During Social Distancing.

Table 2. Self-reports on changes in walking frequency from the onset of Covid-19.

Frequency Change	Percent
Remained the same	22.4
Increased	29.0
Decreased	48.5

Table 2 presents self-reports of general walking frequency, wherein 48.5% of those responding reported that their walking frequency had decreased. The fact that walking frequency tended to go down is telling, given that the data was collected during summer months when we might expect people to be more likely to be outdoors. A thematic analysis of open-ended comments also lent itself to supporting this data.

A total of 221 individual responses were received to the follow-up question, 'Why has the frequency of your walking remained the same, increased or decreased?'. Upon the completion of the analysis, a total

of 9 major themes had emerged, which was supported overall by 218 responses and minor insights from 3 responses. The inclusion of the 'minor' insights is done as a representative look at possible atypical responses that are sometimes overlooked. Presenting the minority perspective gives those individuals a voice in the larger conversation surrounding the impact of COVID-19 restrictions.

Many responses pointed to the overall themes of "having less of a reason or motivation to go outdoors," as well as "an increased level of fear and risk mitigation in avoiding possible exposure to COVID-19. "In contrast, 29% of respondents indicated an increase in their walking habits, and there were themes that supported this, which included "maintaining/improving physical and mental health"; "ease of going out for walks." The theme "ease of going out for walks" is also supported by some respondents indicating ease in finding safe, walkable areas and having more time at home as their reasons for this. It is possible that pedestrians are now finding it easier to go out for walks since commuting to the office or school is now reduced, along with no longer having to remain at the office or campus during the day. Interestingly, having more time at home was given as a reason for a decrease in walking by some but for an increase in walking by others. It is possible that despite having similar circumstances, the difference in response can be traced back to everyone's risk perception of how 'safe' it is outdoors where some would choose to go outdoors to maintain their mental and physical health, others may find that fear of the risk of being exposed to COVID-19 outweighs their desire to go outdoors for leisurely or health maintenance reasons.

Almost one quarter (22.4%) of respondents indicated no change in their walking habits. Within the qualitative data, 3 persons contributed to the theme of "having no change in their daily habits and routine either by choice or need." Another respondent is quoted as saying, "I still need to live my life," indicating that normal activities must still go on despite COVID-19 being around.

Minimal themes were also present that contradicted some of the larger, overarching themes. Minimal themes were expressed by 1-3 persons and may not be as common throughout the general population as other themes. It is still important to mention these, as they may be representative of situations or reasonings experienced by some residents of the Waterloo Region. An example of a "minimal theme" includes 'going out to see people,' and was expressed by one respondent as "…walking as a way to see other people…get out of the house.", which was part of a larger comment, indicative of a person not

necessarily going out to socialize but more so to be in the presence of other people. Although this was only expressed by one person, it was not out of place given the high response rate of persons who indicated that they are home more often, and of course, this would mean seeing fewer persons than is typical in times without COVID-19 restrictions.

A second minimal them can be described as "driving most of the time," which was indicated by one person and seemed to be related to using driving as their main means of transportation. Although individuals who drive most of the time may not be the typical persona discussed when examining pedestrian behaviour, insights from this respondent still adds value to this research study. It is likely that at some point, a "driver" will walk in public, even if for a short distance, and interactions with other pedestrians can occur. Understanding the behaviour of an infrequent walker helps to construct the mental model of that group of pedestrians and enables recommendations to be made for all types of pedestrians within Waterloo Region. It can be surmised that this person relied on driving as transportation prior to COVID-19, and there were not any major changes to their walking habits. Although this was only expressed by one respondent, given that the web survey was focused on pedestrians, it is possible that those who mostly drive would choose not to participate in this survey as it was targeted at pedestrians. Therefore, this theme may be larger than what is represented within the survey results.

"Major changes in work or living situation" was expressed as a minimal theme despite changes being seen by everyone because the reasons given in the comments by the three respondents were events that happen less frequently. These included graduated from university, getting a new job as well as moving to a new home with a fenced-in yard. The final minimal theme, "walking more to avoid public transit," was only expressed by one person and was contradictory to a major theme of going outdoors less to avoid others. This respondent increased their walking frequency as a transit replacement.

4.6 Social Distancing Scenario Responses

When presented with ten social distancing scenarios, each describing different urban walking contexts, most respondents reported that they would step off their current path or sidewalk to create distance with others in the scenario, and this was seen in 7 of the scenarios. In two scenarios (4 & 6), most respondents chose just to stop moving, and in one scenario, respondents chose to continue their path or make no

change. A summary of the social distancing scenarios by forced-choice options can be found in Appendix E. An in-depth analysis of each social distancing (SD) scenario is presented.

4.6.1 SD1: Pedestrian encounter in a park.
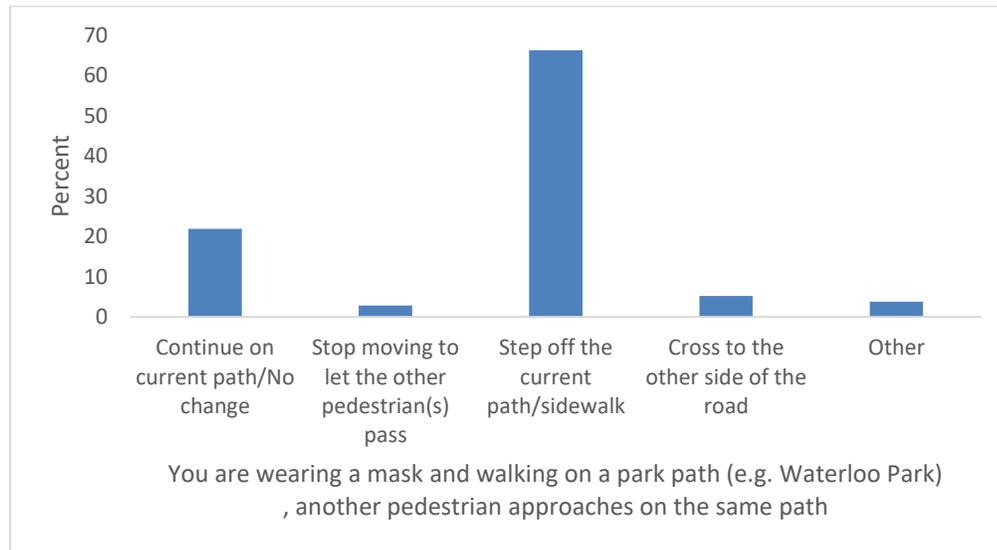
Figure 3. Pedestrian encounter in park, summary of responses.

As shown in Figure 3, most respondents chose the option to step off the walking path (66.2%). Within the open-ended responses, we also see a strong response for 'moving,' where 5 out of 8 comments indicate moving away as their reaction of choice in this scenario. Creating as much distance as possible from the other pedestrian is also indicated strongly within the open-ended responses. Also noted were two other minimal themes of 'increasing walking speed' and 'the width of the path determining the specific actions.' Compared to the comments for other scenarios, it is possible that with the available green space near the path, pedestrians would choose to continue walking on the green space compared with stopping, which was indicated in Scenario 2, which took place on the road environment. When looking at both closed and open-ended responses, in a scenario in which there is available space adjacent to the walking path, the first response by pedestrians will likely be to move off the path or as far away from others, while still on the path, if social distancing is possible.

Given that this scenario used a local park (i.e., Waterloo Park), it is possible that respondents were familiar with the width of the park path and were able to visualize the scenario clearly. It is also possible

that encountering a pedestrian wearing a mask in the scenario did not seem to impact respondents' choice to stay on the path. This will be seen as similar to when respondents indicated that mask wearing did not reduce their desire to physically distance themselves from others (section 4.7).

4.6.2 SD2: Pedestrian encounter on a sidewalk with a group walking behind
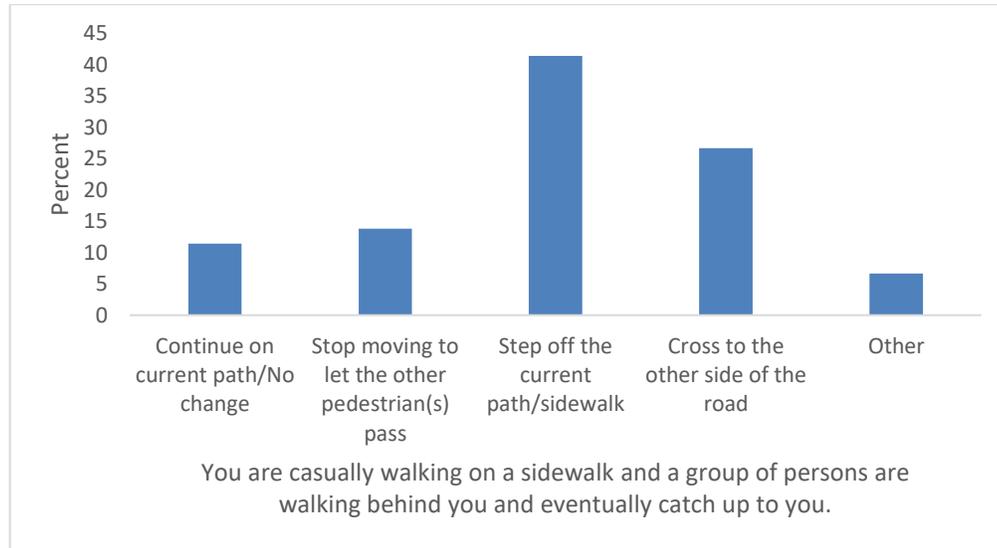
Figure 4. Pedestrian encounter on a sidewalk with a group walking behind, summary of responses.

In this scenario, many respondents selected stepping off the current path (41.4%) and crossing to the other side (26.7%). Most open-ended responses indicated a choice of stopping and moving out of the way to create distance and allowing the group to pass. Increasing walking speed was the next theme emerging, although this was only represented by three persons. Interestingly, a different approach was suggested by two respondents in which their approach involved a strategy of offence that involved blocking the path of the group and not letting them pass and confronting them and telling them to keep their distance. Although it is important to note these comments, they are a minority and not likely an approach that most persons would take, and this is seen with other responses in which an avoidance strategy is preferred. Examples of avoidance included four persons opting to increase their walking speed to avoid the group catching up to them, and six persons indicated that they would stop and move away to allow the group to pass them. Another response noted by one respondent was the choice of crossing the road to avoid any interactions with the group.

4.6.3 SD3: Pedestrian encounter on a sidewalk with another pedestrian ahead
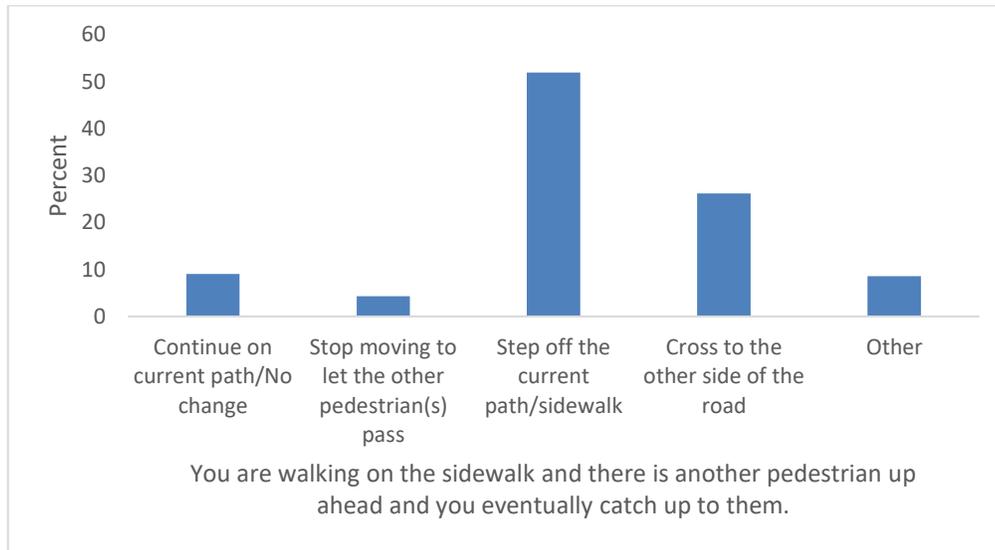
Figure 5. Pedestrian encounter on a sidewalk with another pedestrian ahead, summary of responses.

In this scenario, most respondents chose to step off their current path (51.9%), followed by crossing to the other side of the road (26.2%). Within the open-ended comments, a strong preference for adjusting walking speed was seen, whether by increasing walking speed to overtake and keep a distance or slowing down walking speed and staying behind while maintaining distance. Respondents also indicated walking in the road or a private property to create distance, and one respondent indicated looking for an alternative route to pass the other pedestrian. One respondent indicated they would ask the other pedestrian to allow them to pass. This type of response was again in the minority compared to the other types of responses received.

4.6.4 SD4: Walking with a baby stroller
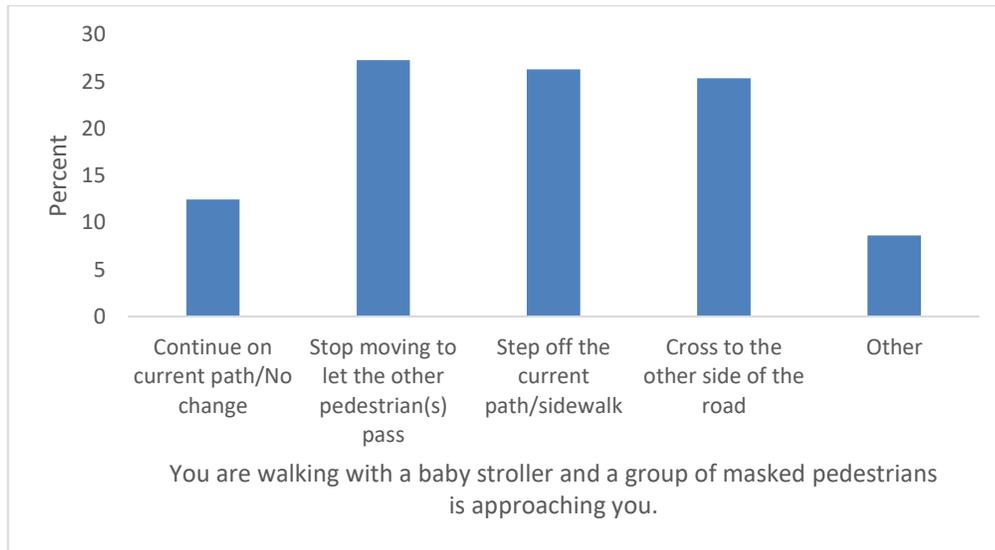
Figure 6. Pedestrian walking with a baby stroller, summary of responses.

As can be seen in Figure 6, most responses were split between 'stop moving to let other pedestrians pass' (27.3%), and 'step off the current path' (26.3%). This scenario, along with scenario 10, were the only two in which choosing to stop moving had the largest proportion of responses from respondents. These were also the only scenarios that involve babies or a third party. It is possible that respondents view scenarios with vulnerable others (e.g., babies) as ones in which more caution must be taken. Additionally, there were also responses that seemed to be decided based on what the approaching group did which then dictated the move that the respondent would choose to make. This may further back up the argument on vulnerable individuals, in that generally adults will accommodate those perceived to be more vulnerable.

4.6.5 SD5: Walking on the sidewalk of a busy road
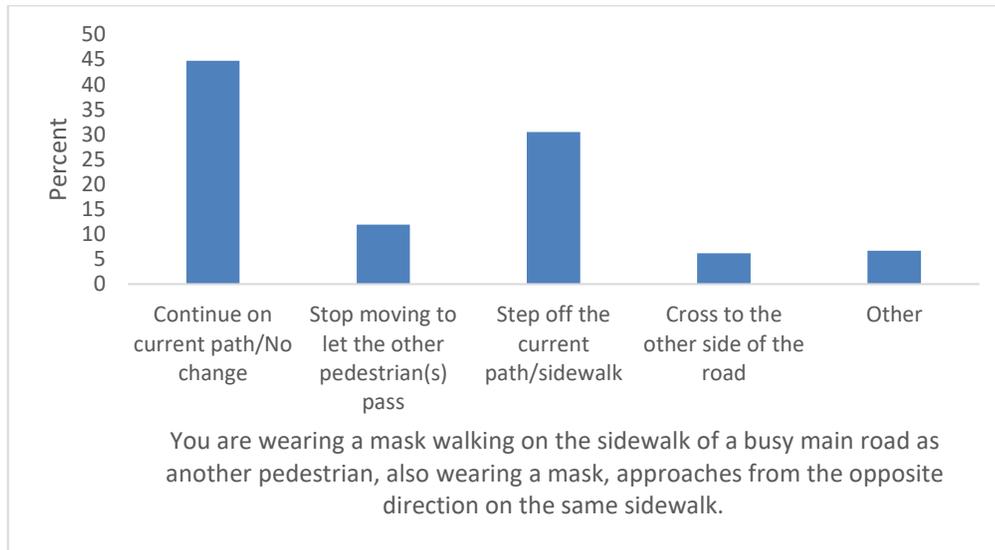
Figure 7. Pedestrian walking on the sidewalk of a busy road, summary of responses.

As shown in Figure 7, most respondents would choose to continue their current path with no change (44.8%). The majority of open-ended responses included: "turning their face away," refusal to walk in a busy area, looking for an escape route, which was expressed by fourteen of the fifteen respondents. The outlier response was: "indicate to the other pedestrian to move," which was indicated by one respondent. This scenario is an interesting one because it illustrates a scenario in which there are limited options and space available between pedestrians.

The responses to this scenario may indicate how pedestrians would respond in other types of scenarios, such as walking in areas with construction taking place or even during winter conditions in which snow maybe along the sidewalk, and the available walking path space is reduced. It suggests that in situations in which the available walking space is reduced, pedestrians must improvise to maintain social distancing when 'step off the path' is not feasible.

4.6.6 SD6: Encounter with another pedestrian at an intersection
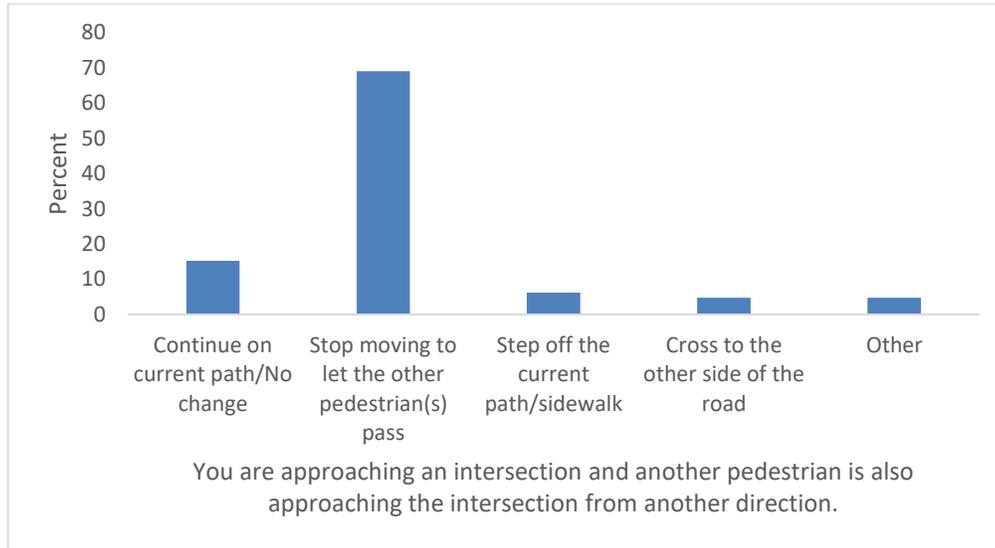
Figure 8. Pedestrian encounter with another pedestrian at an intersection, summary of responses.

As shown in Figure 8, the majority of respondents would choose to step off the path (69%). Within the open-ended responses, respondents indicated the additional choices: changing of walking speed to avoid meeting the other pedestrian at the intersection (nine of ten responses) either by speeding up or slowing down in order to maintain a distance from the other pedestrian. Another option presented in open-ended responses was: "evaluate who got to the intersection first and decide whether to allow them [the other pedestrian] to pass or for me [them] to go ahead (one respondent)." An outlier response, indicated by one person as a part of their response, was to ask them [the other pedestrian] to keep their distance if necessary.

Based on the responses given for this scenario, respondents are making choices to actively avoid encountering the other pedestrian present. It appears that respondents would use the available infrastructure to their advantage to practice social distancing.

4.6.7 SD7: Encounter in a neighbourhood with multiple pedestrians
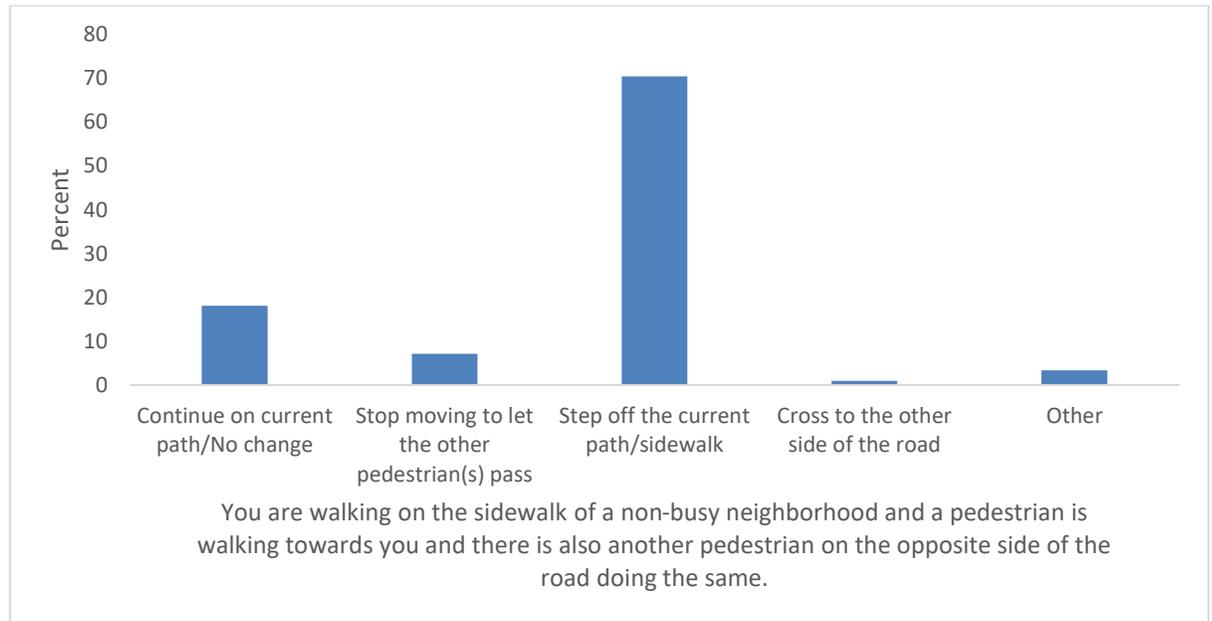
Figure 9. Pedestrian encounter in a neighbourhood with multiple pedestrians, summary of responses.

As shown in Figure 9, most respondents chose the option to step off the walking path (70.5%). There were seven open-ended responses given. Within the open-ended responses, six out of the seven comments indicated moving onto the road or grass to walk. Notably, one of the respondents that indicated stepping onto the road to walk also mentioned the qualifier of 'no cars approaching' for them to decide to take this action. A response such as this may indicate a level of risk assessment by the respondent within their decision-making process. Creating as much distance as possible from the other pedestrian is indicated strongly within both open and closed-ended responses. One respondent also indicated increasing their walking speed to maintain distance. An outlier response of "making hand motions to communicate the other pedestrian to stop" was made by one respondent.

4.6.8 SD8: Encounter on a busy road with a group of pedestrians
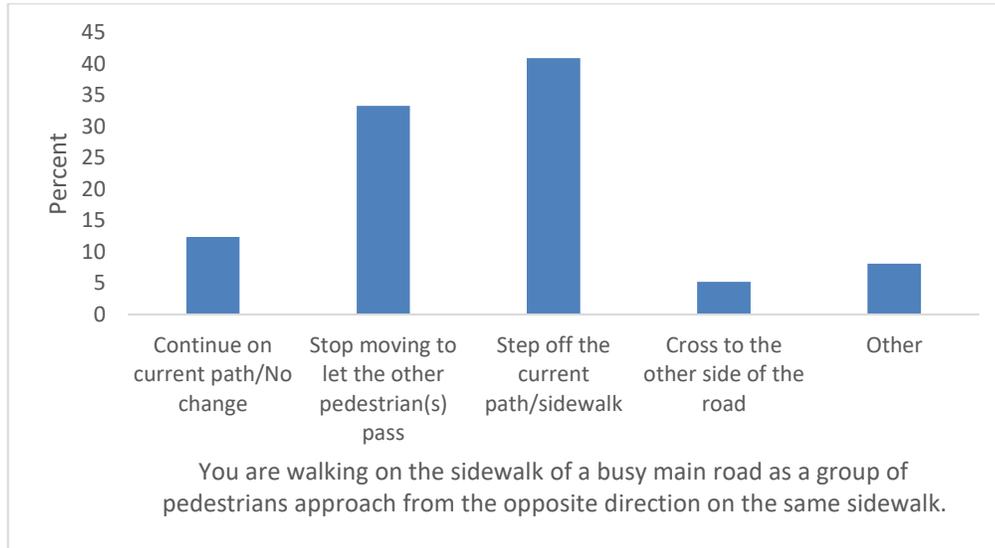
Figure 10. Pedestrian encounter on a busy road with a group of pedestrians, summary of responses.

As shown in Figure 10, most respondents chose the option to step off the walking path (41%) or to stop moving (33.3%). There was a total of sixteen open-ended responses. Within the open-ended responses, two respondents indicated that they would change their walking direction, two respondents indicated that they would look for an escape route, one respondent indicated that they would increase their walking speed, one respondent indicated that they would move to private property, one respondent indicated that they would turn their face away. Moving to the edge of the path was indicated by four respondents, with one respondent adding that they would "hope" the group would do the same. It was also mentioned by one respondent that they would step onto the available green space.

The responses received for this scenario differed slightly from those received in the previous scenario. Within open-ended responses, there was a variety of responses given with indications that just stopping or stepping off the path might not be feasible, depending on the situation. For example, the responses indicating the use of hand motions, asking for space, or making eye contact took a more direct approach in their attempt to maintain distance by communicating with the group.

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4.6.9 SD9: Encounter in a neighbourhood with multiple pedestrians and a homeowner
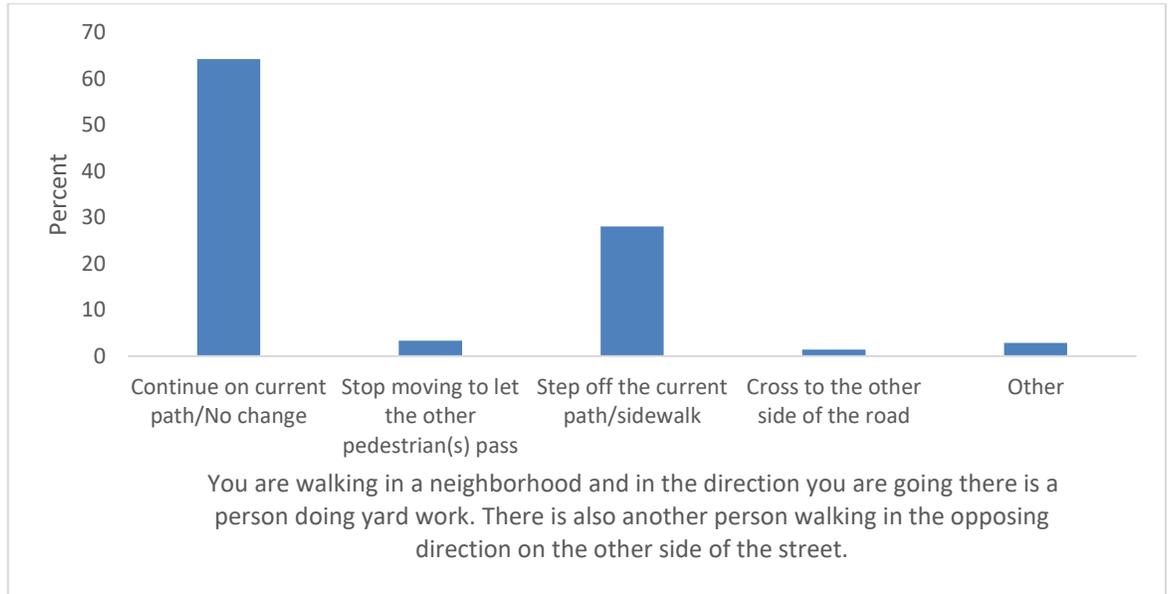
Figure 11. Pedestrian encounter in a neighbourhood with multiple pedestrians and a

homeowner, summary of responses.

As shown in Figure 11, most respondents chose the option to continue on the walking path (64.3%) or stepping off of the current path (28.1%). This is one of the two scenarios in which the option of "stop moving" was not selected by the majority of respondents. Within the open-ended responses, responses included: stepping off of the sidewalk if the homeowner is close to the road; moving to the edge of path or road to distance (depending on traffic volume); walking to the edge of the sidewalk or road to distance from homeowner; increasing walking speed.

4.6.10 SD10: Encounter in a neighbourhood with multiple other pedestrians
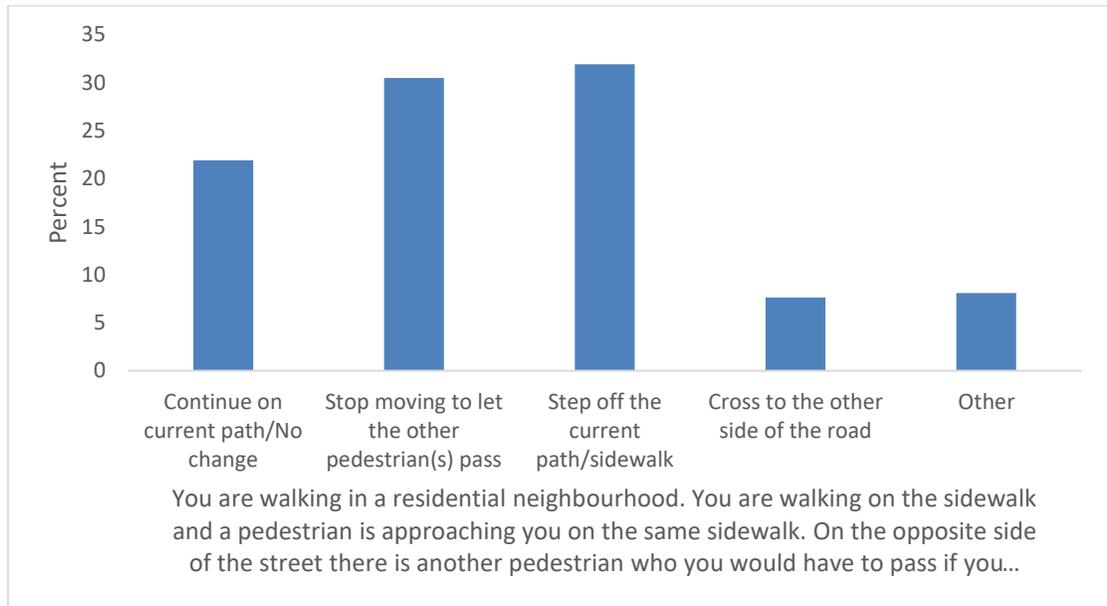
Figure 12. Pedestrian encounter in a neighbourhood with multiple other pedestrians, summary of responses.

As shown in Figure 12, the majority of responses were split between: step off the current path/sidewalk (31.9%), stop moving to let the other pedestrian(s) pass (30.5%), and continue current path (21.9%). This was the final, and most complex scenario presented to respondents, and this is evident in the split in choices and a higher number of open-ended responses. Open-ended responses included: - "go home, too much traffic"; "could not respond"; "step onto a lawn"; "hold breath"; "If the mothers and babies are walking the same direction as me, I would step into the road and follow them at a distance until I could get back on the sidewalk. If they were walking towards me, I would step into the lawn of the house I am in front of and continue walking"; "Stand-off of sidewalk and mutter passive aggressively at the mothers;" "This scenario does not indicate where the mothers are moving. I would walk into the road and stop until the pedestrian on my side passed, then continue the sidewalk, maintaining distance from the strollers."; "jog on the sidewalk to overtake moms"; "step onto lawn or road, stop for moms and overtake person walking towards me"; "walk on lawn to overtake the person on the same sidewalk."

4.7 Impact of Completing Survey on Perceived Pedestrian Comfort

Figure 13 presents the results of respondent reports on whether completing the survey had impacted their perceived comfort around approaching other pedestrians during the pandemic. Only 4.4% of respondents indicated feeling more comfortable approaching other pedestrians after taking the survey, and 50.5% indicated no change in perspective. A sizable portion, 45.1%, indicated now feeling less comfortable with approaching other pedestrians after taking the survey. This can be looked at from two perspectives. Completion of the survey may have impacted respondents' thoughts about approaching other pedestrians by increasing their awareness of the risk of exposure to COVID-19 in a variety of scenarios. On the other, the respondents have been made more aware of their actions while walking in public, and this may signal a positive result from using a survey as a tool to increase social distancing considerations among pedestrians.
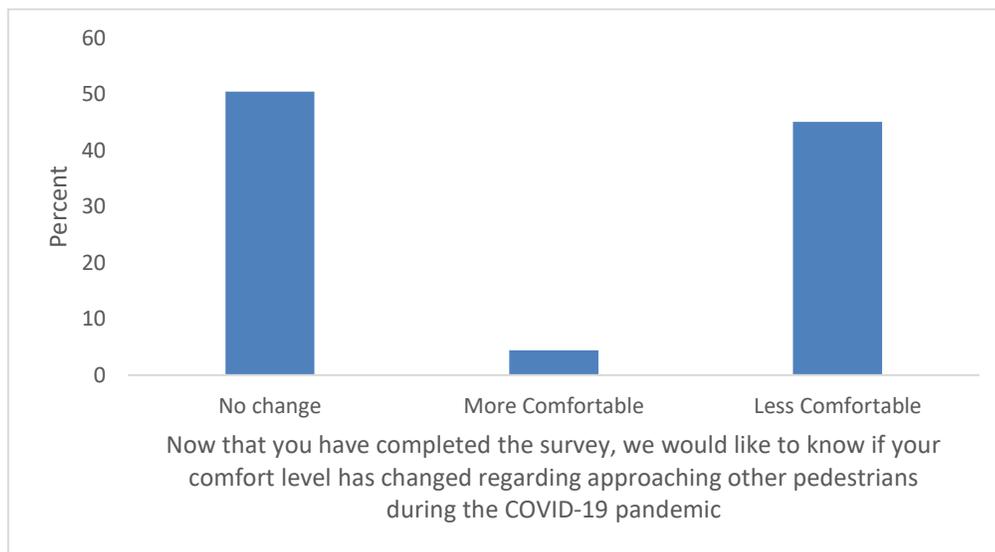
Figure 13. Comfort level approaching others, after survey completion.

4.8 Maintaining Social-Distancing While Walking

When presented with the statement, "I am more aware of my proximity to other persons when it is a group of persons compared to one other person?", 73% of respondents indicated having a higher level of awareness of their proximity to others when around a crowd of people compared to one other person, and 19.4% indicated that being around a crowd of people does not give them a higher level of awareness compared to being around one other person. Further, as shown in Table 3, when presented with the

statement "When I am wearing a mask, I am not worried about maintaining social distance (i.e., 6 feet) from other pedestrians or cyclists," only 12.7% of respondents indicated having no worry about distancing from others in comparison to 79.8% that indicated otherwise. It is likely that when near a larger number of other pedestrians' risk awareness is approximately directly proportional. This is supported by some of the new pedestrian rules to be discussed in Chapter 6.

Table 3. When I am wearing a mask, I am not worried about maintaining social distance (i.e., 6 feet) from other pedestrians or cyclists.

Response	%
Yes	12.7%
No	79.8%
No response	7.5%

As shown in Table 4, when presented with the statement, "When I encounter other pedestrians wearing masks, I am not worried about maintaining social distance (i.e., 6 feet) from other pedestrians or cyclists," only 16.3% of respondents indicated having no worry about social distancing when encountering others in masks, compared to 76.6% who stated otherwise.

Table 4. When I encounter other pedestrians wearing masks, I am not worried about maintaining social distance (i.e., 6 feet) from other pedestrians or cyclists

Response	%
Yes	16.3%
No	76.6%
No response	7.1%

Table 5 presents results around perceived comfort. Pedestrians are not reporting a higher level of comfort when they are wearing masks or when others are wearing masks. It is surmised that pedestrians do not see masks as a replacement for social distancing. It is interesting to note that a greater number of respondents indicated no worries when the other person is masked compared to when they themselves were masked. This does align with messages being presented to the public at the time of data collection, which stated that wearing a mask is more for the protection of others than protecting yourself (Health, 2020). On the other hand, it is not fully known how respondents would have interpreted the wording of the question, and results should be interpreted with caution.

Table 5. I am comfortable with my ability to follow social distancing when I am in a crowded, public area (e.g., a park, mall)

<u>Response</u>	<u>%</u>
Yes	51.6%
No	41.3%
No response	7.1%

4.9 Countermeasure rankings and Social-Distancing Guides

As shown in Table 6, respondents' ranking of visual aids is presented in terms of the order that respondents believe them to be effective in assisting with gauging social distancing measurements. The images are listed in order from highest ranked to lowest ranked by respondents. As shown in Table 6, the countermeasure ranked first is a sign posted on a pole located in Waterloo Public Square; the countermeasure ranked second is a banner indicating social distancing guidelines; the countermeasure ranked third are ground markings; the countermeasure ranked fourth are traffic cones indicating social distancing; the countermeasure ranked fifth is a ground marking with social distancing guidelines; and the countermeasure ranked sixth is a ground marking in Waterloo Park, the Waterloo Region. The first and second-ranked visual aids differ from the rest in that they are at eye level to a typical pedestrian. This may be indicative of pedestrians not looking down naturally as they walk and feeling as if a visual aid that is at approximately the same height as a normal road sign may be more noticeable and,

therefore, more effective. Surprisingly, the sixth and lowest-ranked aid, also located in The Waterloo Region, was ranked as least effective. Despite differences in the rank means for each countermeasure, a review of the associated standard deviations suggests no aid was ranked overwhelmingly higher or lower than the others. Given that respondents were not given an option of no-response or an option of giving an open-ended comment, it is possible that the interpretation of the results can only be made within the context of the options and instructions given. Therefore, although having a forced-choice format meant that respondents had to answer within those confines, which aids they believe to be most effective, it is possible that with a different question format, e.g., select the aid(s) that you believe to be most effective, the results might be clearer

Table 6. Visual Aid (VA) Rankings.

Visual Aid	Image	Rank	Mean	Std. Dev.
VA#1 Sign on Pole		1	5.39	1.27
VA#2 Banner		2	4.47	1.28
VA#3 Ground Marker		3	3.28	1.32
VA#4 Traffic Cones		4	2.93	1.57
VA#5 Ground Marker		5	2.47	1.24
VA#6 Ground Marker		6	2.14	1.21

4.9.1 Visual Aid Rankings Discussion

When asked about their opinions about the helpfulness of markers on the ground for determining correct physical distance, 78.43% indicated yes, and 21.57% indicated no. This question was asked similar to the visual aid ranking question (see Table 6), which also had a forced-choice response format. Having a forced choice meant that respondents had to choose either yes or no, and this left no room for neutral responses. Given that this is somewhat of a follow-up question to the visual aid ranking one, respondents were asked to make a forced choice that would make these results comparable.

Despite the majority of positive responses to the visual aids presented in the survey, the negative responses do indicate that a portion of pedestrians do not find visual aid markers on the ground helpful. Given that there was no space for further explanations, it is unknown what the exact reasoning for this might be, and this is further explored in Phase II.

4.10 Value and Limitations of Phase I Survey and Analysis

4.10.1 Survey Design

The use of the remote web survey was a convenient method to gather data from a portion of the current residents of the Waterloo Region. This allowed for easy access for those with an internet connection to participate. For this study, the survey gave the researcher insights into which subsections of the population made up most respondents and, in turn, which group(s) to focus on within the next phase for additional insights. Closed-ended survey responses also allowed for quantitative analysis to take place that would not be possible while using a qualitative only method. This allowed statistical analyses to be run to answer specific questions like: 'Is there any differences in the walking frequencies of different age ranges?' 'How many persons have reduced their walking frequency since March 2020?"; 'Is there a difference in the avoidance behaviours exhibited by different genders? Although the answers to these questions can be elicited from an interview, the responses may not always be comparable across the board or given in a standard format such as the case of a survey.

4.10.2 Convenience Sampling (value and limitations)

Despite the convenience of surveys being an advantage, it can be a disadvantage as well (Glasow, 2005). The ease of participating lowers the barrier for entry of respondents who are not eligible participating (e.g., seen in the high number of responses needed to be eliminated from the dataset in

which persons indicated not being in the Waterloo Region; or persons indicating they are in the region but are not, and this can skew the reliability of the data.). A major disadvantage of online survey administration is the limiting of responses to those who have access to the internet and technology and those literate in English, as the survey was distributed electronically and unilingual. There is also a risk of respondents completing only a portion of the survey (This was another cause of eliminating responses where most of the survey was left incomplete), and a moderate-high dropout rate is common for surveys of this type (Manfreda et al., 2008). Some of these incidents were noted in our own research in which a total of 332 responses were collected, but after scrutinizing the data, only 252 valid responses were left for further analysis.

Despite the limitations, a survey method was chosen to quickly collect information, given the evolving social distancing restrictions in what was a first look at this specific population (i.e., adult pedestrians in Waterloo Region) and their behaviours during social distancing situations.

4.10.3 Qualitative vs quantitative analysis

When looking at the advantages and disadvantages, one might recommend that depending on the purpose of the survey used, it is not used as the sole vessel of information gathering. Using a survey in conjunction with other data collection methods, such as a semi-structured interview, not only allows for more information to be gathered but also a confirmation of information collected as well as deeper insights into the survey data collected.

4.10.4 Use of Phase I insights for designing Phase II

Results and insights obtained during Phase I survey analysis were used to inform the design of Phase II of this research study. These insights allowed for the highlighting of pedestrian behaviours, actions and motivations that would benefit from being included in the semi-structured interviews. They also provided a starting point for the understanding of pedestrian mental models with the knowledge of which actions pedestrians generally choose to take during their walking processes while following social distancing measures within the Waterloo Region. Further insights into the 'why' behind these actions are explored in Phase II.

Chapter 5

Phase II: Semi-structured interviews for uncovering social distancing strategies

5.1 Semi-structured Interviews

This chapter describes the semi-structured interview and guide created to gain deeper insights surrounding social distancing situations for adult pedestrians within the Waterloo Region to build on information collected in Phase 1. The interview design, inclusive of question selection and creation, will be presented along with the interview recruitment methodology and the demographics of participants. This study received ethics clearance (ORE # 42348) through the University of Waterloo Office of Research Ethics and was conducted as stated in the approved protocols. (See Appendix F).

5.2 Semi-structured Interview Design

The semi-structured interview protocol used for this research study was designed following an adaptation of the methodology used by Indi Young (2008) in her mental model formulation process. Young's methodology utilizes semi-structured interviews to create mental models. Similar to previous discussion (Section 2.6) on methods of studying pedestrian behaviour, mental models are usually constructed with the use of observational or lab-based experiments (Gilbert & Rogers, 1999); however, those methods were not feasible for this thesis research study. Based on responses collected within Phase I, it was determined which questions or points would be followed-up for deeper insight. As part of the interview participants were asked to describe a recent walking experience as a way to understand what the walking process encompassed for each person. Questions were asked about thoughts and actions taken when encountering others in public settings, and precautionary measures taken prior to and during walks. Questions were also asked about the infrastructure encountered, mask wearing, social distancing aids encountered in public, and suggestions that they had about COVID-19 measures.

For our study, the target number in each category (e.g., age range, gender) was determined based on the specific results given in Phase I (survey) of the study. Potential interviewees were selected as closely as possible to represent the specific proportion of respondents in each category. A representative sample of interviewees was selected to account for possible differences in the mental models of

pedestrians varying in age and gender, walking purpose, and walking location. Like Indi Young's approach, there may be individuals who overlap and fit into multiple categories, and they can be interviewed as a part of the multiple categories (e.g., across age, gender, walking locations and reason(s) for walking.

5.2.1 Semi-structured remote interview screener

At this stage, an interview screener survey was created that included questions on demographics and walking frequency (see Appendix G). These were asked to ensure that interviewees were selected that represented a proportion representative of those in Phase I and that it included those that had a weekly walking frequency of at least one or more times.

5.2.2 Semi-Structured Interview Method and Rationale

Although the interviews followed a semi-structured format, a guide was used (see Appendix H) to gather key points from the interviewees. The purpose of these interviews was to build onto and elaborate on the initial data gathered from the survey in Phase I. A strong focus was on understanding what pedestrians do in different situations when encountering other pedestrians. Given that most respondents in the survey indicated walking in suburban areas, parks, or trails and in downtown areas, questions focused on these settings. As an opener and to get participants comfortable with talking about their walking experiences, they were asked to talk about any walking experience of their choosing, with any details they felt were relevant. This, along with follow-up questions from the researcher, was a subtle way of introducing interviewees to the components of their walking experiences that would be highlighted. Participants were also asked specifically to talk about their walking experience in the form of a process, detailing what actions or thoughts take place in the period before walking, during walking and after the walk. This 'process' formed a major component of the mental model that was created based on responses.

When asked about past or proposed walking behaviours in different settings, participants were asked about their reason for walking, length of the walk, comfort level, the presence of any visual signs or aids about COVID-19 and/or social-distancing, the presence of other pedestrians/persons and their reaction to this. In addition, comparisons between similar walks prior to social distancing were also asked. Participants were also asked how they personally gauge distancing between others when in

public, the impact of any aids present or their thoughts or behaviours. Finally, interviewees were given the opportunity to indicate one major problem and/or solution they would want to see implemented in a perfect world, as it relates to COVID-19 and current social distancing measures. Despite the lighthearted nature of this question, this allowed the researcher to determine what is a core thing that is frustrating or a nuisance to the participant that may not have been indicated through the previous survey or interview session. The remote interviews were conducted via Microsoft Teams.

Most survey respondents had reported walking in downtown areas (60.3%), parks or trails (58.3%) and suburban areas (56.7%), respectively. This suggested that these are the areas that most Waterloo Region pedestrians walk. Therefore, this was the focus of the interview questions related to walking locations. Initially, the focus of the interviews was to be on outdoor public spaces, but after participant 5 went more in-depth about their experiences while indoors, this was discussed freely if relevant in the three remaining interviews. Participant 5 discussed not only their experience navigating in a store and salon but also mentioned the why behind the actions that they took. The topic of social distancing while indoors did come up organically in other interviews where the participant had been indoors in public since March 2020. Participant 7 mentioned their cycling habits, and these were noted; however, this was not brought up in any other interviews, and it did not have any significant impact on the mental model creation process.

Collectively the interview responses extend the understanding of results from Phase I. Specifically, insights were gained about comfort levels around other pedestrians and why, mask wearing habits, reasons for walking, how long and where, as well as thoughts surrounding current and potential future countermeasures, including engineering, education, or penalties.

5.2.3 Pilot Testing

For Phase II, a small sample (N = 2) of those who participated in the Phase I survey pilot testing were invited to participate in pilot testing of the remote interview. The sessions followed the same procedure as the official interviews, including explaining to interviewees their rights and consent as well as the purpose and format that the interview would be taking. During these sessions, the focus was on streamlining the interview process, inclusive of recording, note-taking and questions put forth to the interviewees. The results of these pilot interviews allowed refinement of the interview questions,

recording process and allowed a practice analysis to create a composite mental model based on the results (see Appendix I).

5.2.4 Participants

In the survey, respondents had the opportunity to indicate their willingness to be contacted for a follow-up interview. Based on the demographics of survey responses, potential participants for one-on-one remote interviews were selected from the 18-54 age ranges, with attempts to include male and female respondents. The 18-54 age range is representative of the largest proportion of adult residents of the Waterloo Region. Interview sample sizes are typically chosen based on the principle of saturation, which states that after a certain number of interviews, no new information is obtained; however, this number is not set-in-stone and is variable within each study (Glaser & Strauss, 2006). Given time constraints to complete the thesis research, continually interviewing until the point of unknown saturation was not feasible. It was decided to base the sample size on the findings of (Guest, Bunce, & Johnson, 2006), who found that twelve interviews were sufficient to achieve saturation. As well, Young (2008) determined that having 4 data points within each selected category (i.e., age, gender, walking frequency, walking reason, walking location), even if multiple points are from the same participant, is enough to achieve saturation in mental model development.

The original target was for 12 participants; however, only eight people agreed to be interviewed. All (18 respondents) remote interview screener survey respondents that were eligible for participation, based on weekly walking frequency, were sent a follow-up email containing an attached information letter, a link to the consent form, and an invitation to schedule the remote interview. Incomplete or incorrect contact information prevented follow-up in some cases. Timing or reluctance to devote an additional hour to the pedestrian study may have been another factor.

Eight (2 males and 6 females) agreed to participate in the remote interview sessions. All participants who accepted invitations to schedule a private interview were interviewed. Participant identities were anonymized following a naming protocol that allowed for the removal of data if requested by the interviewee and confidentiality of responses. The eight interview participants represented three age ranges: 25–34-year-olds (4); 35–44-year-olds (3); and one person in the 65-74 age range. The frequency

of daily walking was reported as 0-2 times per day (5); and 3-4 times per day (3). Primary reasons for walking were given as "for pleasure" (8); and "walking to work/school" (1). Walking environments included suburban (6), parks or recreational trails (6), downtown areas (5).

5.3 Procedure

5.3.1 Remote Interview Screening Survey

Persons that indicated an interest in participating in Phase II of this study (i.e., at the end of Phase 1) were contacted via email with an information sheet (see Appendix F) about the remote interview and a link to the remote interview screening survey. The survey consisted of multiple-choice questions about current walking habits (the primary reason for walking, walking location, walking frequency). The questions, which were previously asked in the anonymous survey, were used to determine eligibility for participation in the remote interview portion of the study, particularly weekly walking frequency.

5.3.2 Remote Interview

Participants were interviewed separately. Each remote interview was scheduled for an agreed upon time and was video recorded (if consented by the participant) and audio recorded. The interview consisted of questions designed to assist in understanding the behaviours and thought processes carried out by pedestrians currently practicing social distancing while walking within the Waterloo Region. At the start of each interview session, participants were greeted and informed that the interview would be recorded for analysis purposes as well as a reviewing their consent and ability to withdraw their consent at any time. They were also invited to state any questions, comments, or concerns they would like addressed before the interview commenced.

Although the interview did not use fixed questions to ask each interviewee, an interview guide was followed (see Appendix H). This interview guide focused on a self-reported walking experience with follow-up questions relating to their encounters with others, location characteristics and any other behaviours that took place before, during and after the walk. In addition, questions were asked regarding other common walking scenarios and what they would do in those situations. Final questions were asked about concerns, pain points and desired solutions. At the end of the interview, participants were thanked for their participation and again informed that they would be entered into a gift card draw.

5.4 Insights on Interview & Mental Model process

Although related questions were asked of all eight participants, given the flexible nature of the conversation, there was some variability between each session. This is one of the notable differences compared to a survey questionnaire. Therefore, the semi-structured interview was used to support and expand upon the insights gained through the structured survey. During the interviews, the researcher had the opportunity to explore and dig for deeper insights into questions, and, in the case of video-recorded interviews, observe the body language, facial expressions and tones used by interviewees. Non-verbal behaviours added an extra element of explanation and understanding about some of the responses being given at that time. For example, when asked about walking downtown, participant 5 had a wide-eyed expression and mentioned feeling some stress when recalling this scenario, and then laughed when sharing a detail, suggesting that pedestrian experiences under pandemic conditions are complex. Another example of this is participant eight, who showed excitement and animation whenever describing the frequency of daily dog walks as a meaningful part of their daily life with or without pandemic conditions.

5.5 Phase II Results (Interview)

5.5.1 Interview Analysis

The semi-structured interview analysis was conducted in several stages by the researcher. The first step of analysis involved taking general notes, in a word document, about each interview after they concluded that gave a general summary of what was discussed during each session. Anything that was discussed that related to walking was included in these notes. The next step involved going over the transcripts of each interview while listening to the recordings, and all tasks, actions, feelings, and expectations mentioned by participants were entered in an Excel spreadsheet, illustrated in Figure 14, in which each action was assigned the category of "task" that it fell under, along with the corresponding quote.

Seven of the interviews followed the process described previously; however, there was no video or audio recording for one of the interviews due to technical difficulties during the recording of the interview on Microsoft Teams. The researcher conducted an analysis based on the notes written after the interview session in place of a recording and transcript for this interview.

Figure 14. Example of task list spreadsheet.

Following this, all entered actions within the "task" category were extracted from the spreadsheets, and each action was entered onto a digital sticky note. Tasks were then grouped together based on similarities, as depicted in Figure 15, and within these groupings, the "skeleton" of the mental model began to take form (See Appendix I). An affinity diagramming process was done in order to group similar tasks and actions in a cohesive manner to identify common behaviours. This allowed for the meaningful extraction of interview data in an organized manner (B. Hanington & Martin, 2012).
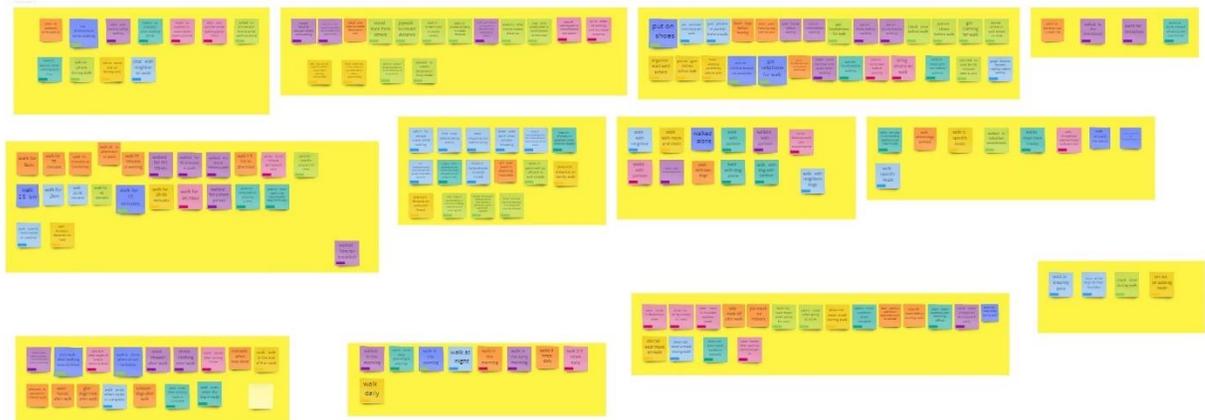
Figure 15. Affinity diagramming of tasks

The definitions given by (Young, 2008) for terminology used within this section are as follows:

- A "task" is a phrase stating an action or step to accomplish something".
- An "atomic task" is the combination of similar tasks to form one overarching task that describes them all.
- A "tower" represents similar but slightly different behaviours that can be summarized as one general action, e.g., planning a walk and mental spaces represent a change in the overall action taking place. There is a clear and obvious change in the actions between each space.

Although we have already drafted our 'mental spaces' or 'towers' to guide our survey and semi-structured interview guide creation, common themes and patterns were grouped together to validate or refute our earlier assumptions. For example, tasks/quotes from the interviews to determine were used to formulate a combined 'atomic task.'

Within the 'towers,' behaviours were further broken down into more specific groupings based on interview responses given. An example of the mental model creation process is visualized in Figure 16, with a sample of data collected from this study. It shows how similar atomic tasks (individual specific tasks indicated during the interviews) are then grouped into a task (a general task that groups and summarizes atomic tasks that are like each other), similar tasks are then grouped into towers (a group of tasks that are all focused on one general theme) and these are grouped into mental spaces (represent

the changes that occur during the walking process) and finally all these together form the mental model(s).

Figure 16. Example of a mental model creation process.

5.5.2 Transcript Analysis

The transcript of each interview was analyzed for tasks relating to walking behaviour. This was inclusive of specific tasks relating to the walking process, feelings, preferences, and thoughts about anything walking-related in a public setting, including outdoor and indoor settings, if discussed.

5.5.3 Solutions desired by pedestrians

Towards the end of the interview, interviewees were asked to indicate one problem to be solved and/or one solution they would like to see implemented that would improve the COVID-19 social distancing experience for them. Solutions that were given encompassed infrastructure, public education campaigns, navigating in public, accessing services and an improvement in testing accessibility. Respondents highlighted frustrations with others in public not adhering to social distancing guidelines when they were doing their best to follow them. The available infrastructure was noted as an aspect in which improvement would be welcome, including more signage regarding social distancing, wider sidewalks, limiting access to public recreational areas, the availability of bike lanes and an overall adjustment for streets to become more pedestrian friendly. Communication between the public and health officials was also noted as an area that would benefit from improved strategies and messages. An improvement in current testing measures and access to proper PPE was also noted as being desired.

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5.6 Pedestrian Rules and Insights

A *rule* refers to " A principle, regulation, or maxim governing individual conduct." ((OED), n.d., Definition 2a). Within this thesis research study, the term "rule" is used to indicate guidelines used by pedestrians to direct their actions during the walking process. A *prompt* refers to "Something said or done to aid the memory; a reminder."((OED), n.d.Definition 2a) Within this study, the term "prompt" refers to questions a pedestrian asks themselves before identifying a rule and taking action based on that rule.

Based on responses given in Phase II of this study, it can be deduced that pedestrians are used to walking without ground-based markers present, or the presence of markers complicates the task of walking. For example, in one of the interviews, an interviewee recalling a trip to a store or mall reported the floor markers used not being intuitive enough because looking down on the ground is not the first reaction, forcing one to re-learn how to navigate (e.g., watching for directional arrows inside of a store). In a similar vein, persons who indicated that they typically walk within suburban areas, based on interview responses, mentioned that no reminders or visual aids were present or noticed on these walks. This points to pedestrians having to determine in their own way what an appropriate distance is when approaching others. For some, this is a simple task. For example, a pedestrian who routinely walks with dogs reported using the dog's 6-foot leash as an easy indicator for determining appropriate social distancing. The dog owner added that due to other people's apprehension around dogs, the habit was already established for trying to maintain distance from others. Another respondent indicated that past instances of seeing visual aids help with 'remembering' distances when no markers are present. Oher interviewees indicated using either their own height or that of a partner lying down as a guide when visual aids are not available. For others, though, determining the correct distance is not such a simple task, and the go-to response is to just exaggerate a distance that they know would be greater than six (6) feet.

A division seen in pedestrian decision making is the choice to follow 'rules' that would benefit self and following 'rules' based on how one's actions may impact others. These 'dynamic' rules also include rules used by pedestrians to guide their distancing with others. Rules within the planning and expectation categories are based on what pedestrians anticipate prior to going on a walk in public. These

rules, found in section 6.6, can be subdivided into those that focus specifically on social distancing related to COVID-19, and those that are more focused on general personal safety or expectations.

A common focus in most of these new rules is that of risk avoidance, which is not unexpected given that pedestrians have usually followed this behaviour, e.g., crossing at crosswalks to reduce accident risk, looking both ways before crossing the street to avoid a collision with a vehicle. This can be seen across both the dynamic and planning & expectation rules. Within the dynamic rules, pedestrians are choosing, as their first response methods that involve avoiding situations or persons that would be risky and essentially increase their risk of exposure to COVID-19. We can also assume that following avoidance behaviour is the preferred method of action for most persons within the region. An example of this is further demonstrated in one rule or questions that some pedestrians ask themselves 'Would it be rude to 'call-out' persons in public who are not distancing?' In this situation, the pedestrians are unsure if it would be 'right' or even courteous to call out others, even though the others are breaking the distancing guidelines. While less obvious, compared to the other 'rules,' it can still be categorized as "avoidance" because the intention is to avoid a possible confrontation or other unknown reaction that can happen if they confront or challenge someone else's behaviours in public. It is possible that this is based on cultural factors and stereotypes (e.g., polite Canadian), as well as general 'known' rules of courteous navigation. Examples of this behaviour may include keeping to your side of the sidewalk, not blocking the sidewalk, walking single file, and walking predictably.

Chapter 6

Phase II: Emerging mental models for pedestrian social distancing

6.1 Emerging Mental Models

This chapter will explore the emerging mental models extracted from the information obtained in both Phase 1 and Phase II of this research study. A brief discussion on insights about the mental models will be followed by a look at each segment of the mental model (s) and the rules and guidelines that are being followed by adult pedestrians within the Waterloo Region.

6.2 Insights on Mental Models

The combined results of the data analysis from Phase I and Phase II highlights that the behaviour of pedestrians is nuanced and can change depending on location, time of day, pre-conceived expectations, presence of others (both strangers and acquaintances), presence of walking companions, characteristics about others that are encountered in public, the volume of persons present in public or personal preferences in the approach to a situation. Some pedestrians have increased their walking frequency in during the pandemic, while others have reduced walking in public spaces to essential trips only (e.g., getting groceries). Some pedestrians choose to go out when the weather is nice, and others stay inside to avoid others out to enjoy the nicer weather. When out, individuals may face dilemma of challenging others to maintain social distancing or remaining silent to avoid confrontation.

Comments made in open-ended responses or interviews point out that change of seasons and weather may impact walking frequency or decisions (i.e., very hot = choose to walk less, nice out = choose to walk depending on their risk tolerance of being around others with a similar mindset.) Seasonal walking patterns habits may need to be considered when looking at solutions and improvements to the walking environment.

Pedestrians seem to account for the infrastructure/walking environment to judge their next move, as well as making a judgement call about others around them (i.e., cyclists and pedestrians). Cues such as body language, perceived abilities of the other person(s) and mask wearing are used to determine next moves. When looked at from a wider decision-making perspective, it is apparent that some changes in decision-making around walking frequency have been brought about because of attempts to follow

health guidelines since the onset of the pandemic. It is unclear if health-motivated walking will continue once the pandemic is over.

Under pandemic conditions, higher levels of stress and anxiety associated with in walking situations are reported. While some raised complaints about the lack of care shown by others (e.g., not wearing masks, failure to distance or at least trying to create space in public), it is noted that there are individuals doubtful of various aspects being reported about COVID-19 and do not see the need to modify walking behaviours.

6.3 Walking process

Although the specific process for each pedestrian while walking in public will be different, there was a general walking process that emerged from the pedestrian mental models. This process is depicted in Figure 17 showing the pedestrian decision-making flow starting before the walk takes place until the walk has ended. Figure 17 includes the major decision-making steps of a pedestrian takes as well as well as specialized decisions. It is through these specific decision choices that the individual mental models emerge.

There is value in looking at both generalized or shared and individual mental models. Mental models of individuals include nuances that a particular person makes, and this individualization allows for the direct comparison or contrast with other members of a demographic group. A generalized mental model allows for identification and examination the common behavioural process shared by members of a demographic group or sample from a larger population. In addition, understanding the group mental model allows for solutions and improvements to a system that would benefit the majority of the group members utilizing it (Jones, Ross, Lynam, Perez, & Leitch, 2011). Figure 17 illustrates the general decisions that adult pedestrians make throughout the walking process.
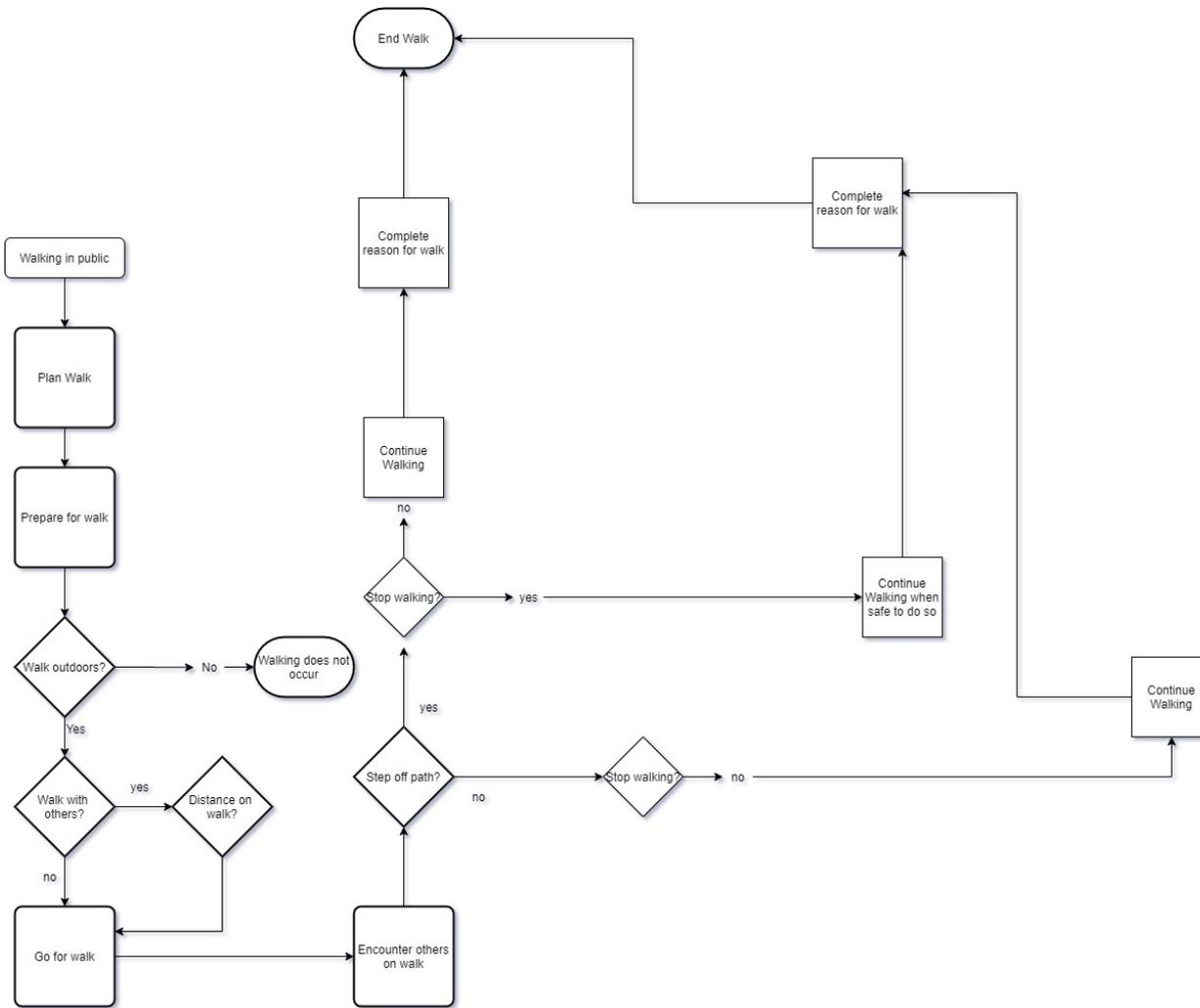
Figure 17. Adult pedestrian walking process generated from pedestrian mental models.

6.4 Dynamic Rules

Rules were extracted from data by examining the task list shown in Figure 14. Interview notes were used to identify actions taken, feelings, and philosophies held about different phases of the walking process. Some of the data also included specific questions or statements that pedestrians were using to govern their movements. Similar to Phase I brainstorming, this process involved the researcher determining the rules being followed based on the questions participants seem to be asking themselves.

Dynamic rules are defined as the rules or guidelines used by pedestrians as they walk in public. Dynamic rules are accessed and assessed continuously by pedestrians when in public with the selected action dependent on the encountered situation. Dynamic rules differ from 'planning and expectation rules' which are generally carried out prior to the walk itself (see Section 6.4 for discussion of planning and expectation rules). Figure 18 illustrates the emerging dynamic pedestrian rule selection process. Dynamic decisions can be classified as either focusing on decisions and actions to reducing risk to self, and those rules focused on guiding actions to reduce risk to others.
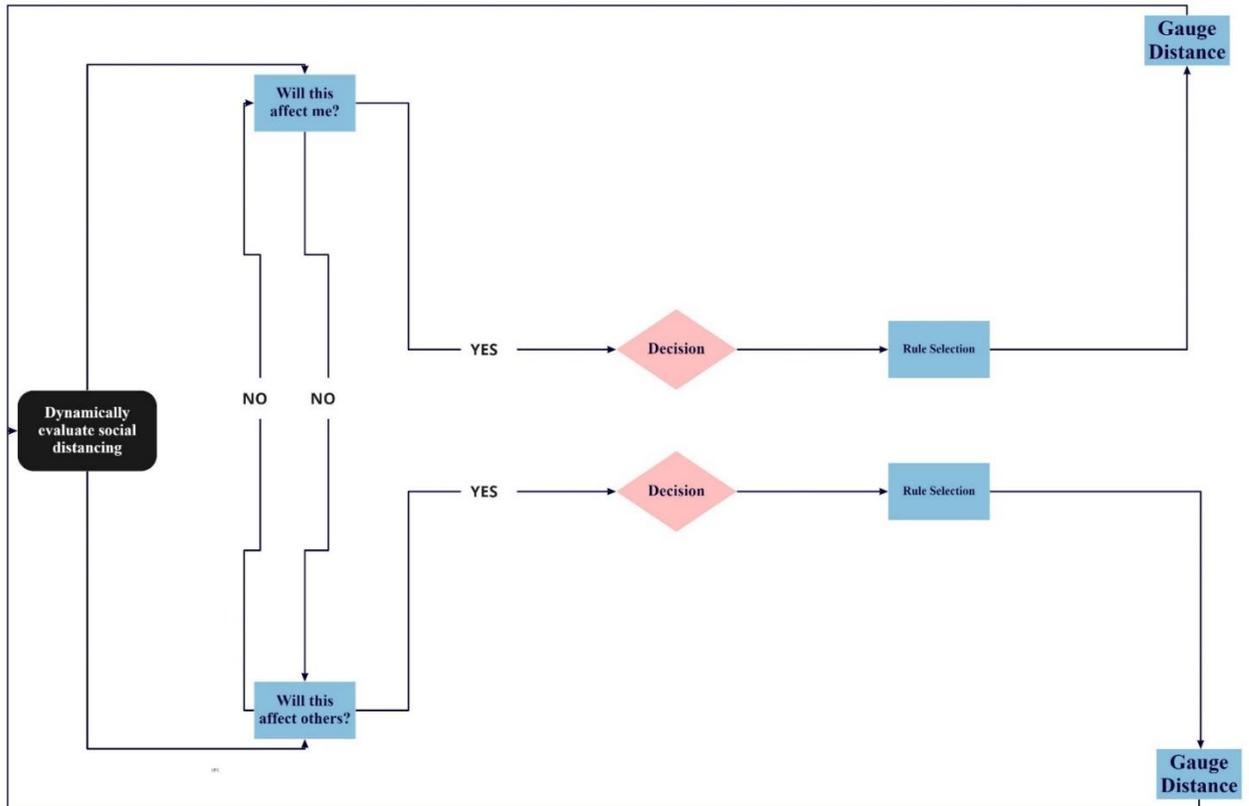
Figure 18. Diagram of the emerging dynamic pedestrian rule selection process. This rule selection process is divided into two classifications:1. A focus on self, and 2. A focus on others.

6.4.1 Focusing on Self: Rules and Guidelines

A decision-making strategy seen within some participants is one in which an action is taken based on its potential effect on themselves. Within this group of rules, pedestrians are not necessarily ignoring others completely; however, the main emphasis is on taking actions that ensure the best possible outcomes for themselves. For example, the rule 'To create social distance, walk on private property rather than on the road,' is in contrast to a rule used when focusing on others 'Only walk on private property to social distance if unavoidable.' The greater focus on self is not concerned with disturbing the property of others and opts to get themselves out of the way of others to create social distance. Both rules mentioned were expressed equally (one mention each) by interview participants during Phase II, and both support the results found in Phase I's social distancing scenario responses (Scenarios: 1,2,3,5,7,10) in which the choice to step off your walking path was selected most often. Further support for this rule can be seen in Phase I -SD8 (see Figure 10), in which most respondents indicated a choice to step off of the walking path while walking in a residential neighbourhood, which may also be indicative of opting to walk on private property to create distance. Open-ended responses to SD8 also indicated stepping onto the green space to create social distance. Table 7 presents a summary of self-focused statements and associated self-focused rules for dynamic decision-making. Figure 19 illustrates the self-focused dynamic decision-making process.

Table 7. Decision Statements and the resulting dynamic rules when focusing on self.

Decision Statement →	"Self" Rules
1. I will hold my breath if distancing is impossible	Hold breath to protect oneself when distancing not available.
2. Walking on someone's private property to create distance is acceptable	To create social distance, walk on private property rather than on the road.
3. It's ok to jaywalk to create distance from another person	Jaywalk, to create distance from another person.
4. If not many cars are present, it is okay to walk in the street/road to avoid others	Walk on the street to create social distance from others.
5. When walking, anything is open to being done once it does not increase the risk of danger	If there are no risks, I will do anything to create social distance
6. If no one is behind the person walking towards me, I will just step to the side	Step to the side of the walking path to create distance.
7. If someone is walking towards me, the first thing I do is look at my surroundings	Examine surroundings when someone is walking towards me.
8. If someone is walking towards me, I'll look for a driveway or green space to step onto	To create social distance, walk on driveway or green space
9. If someone is walking towards me, the contact is minimal	If someone is walking towards me, I will continue walking as normal.
10. If I am walking and catch up to someone, the contact is prolonged [compared to the previous rule]	Walk quickly if walking behind another pedestrian.
11. I am extra cautious when shopping indoors	Be extra cautious when indoors in public.
12. Only gets near to others if nowhere else to go	Maintain distance from others unless it is unavoidable

Dynamic Rules — Focusing on Self — Rule Selection

- Hold breath to protect oneself when distancing not available.
- To create social distance, walk on private property rather than on the road.
- Jaywalk, to create distance from another person.
- Walk on the street to create social distance from others.
- If there are no risks, I will do anything to create social distance
- Step to the side of the walking path to create distance.
- Examine surroundings when someone is walking towards me.
- To create social distance, walk on driveway or green space
- If someone is walking towards me, I will continue walking as normal.
- If I am walking and approach someone, the risk is increased
- Walk quickly if walking behind another pedestrian.
- Be extra cautious when indoors in public
- Maintain distance from others unless it is unavoidable

Figure 19. Diagram of pedestrian dynamic rule selection when focusing on self.

6.4.2 Focusing on Others: Rules and Guidelines

A strategy some pedestrians used when in public is that of concentrating certain behaviours with a focus on others (see Figure 20). Within this group of rules, pedestrians are not only taking actions with themselves in mind but also with the thought of how they will impact other pedestrians or bystanders (e.g., homeowner doing yard work near a sidewalk). Judgments are being made on the best way to distance easily while being courteous or respectful of others. For example, a rule in reference to stepping off the path for an elderly person or for a group walking together (e.g., adults with children). Related is a rule for exercising more caution around those perceived to be vulnerable (e.g., mother with an infant). Evidence of this thought process was found throughout interviews as well as within the Phase I survey responses. For example, in scenario 4 (see Figure 6), in which the respondent is the vulnerable person, respondents were most likely to choose to stop moving. In scenario 10 (see Figure 12), in which mothers with baby strollers were present, most respondents (31.9%) chose to step off the path. These results suggest a general belief among pedestrians that when vulnerable persons (including themselves) are pedestrians in a public space, actions should be taken to make distancing easier for the vulnerable person (i.e., stepping off a path or away).

Emerging dynamic rules suggest pedestrians are continuously questioning themselves about what is going on around them, (e.g., 'What is this person going to do next in this situation?' 'While walking, I always look for escape routes.'). Pedestrians appear to have an increased level of alertness and apprehension on their walks. It is unlikely that most pedestrians were as cautious prior to social distancing guidelines being in place. Despite not having indicated directly what their caution levels were prior to COVID-19, participants alluded to this by referencing "now" when describing such events. Data collected for this research indicate an increase in cautious thought processes, where pedestrians are now expressing a risk factor associated with crowded public areas, particularly those in which distancing is not simple or straightforward. Some pedestrians indicate uncertainty about what to do in situations when other pedestrians are not being mindful of social distancing guidelines, (e.g., 'Would it be rude to 'call-out' persons in public who are not distancing?'). Thematic analysis in Phase I and Phase II found "crowded areas as riskier" to be commonly acknowledged as a growing concern.

Under pandemic conditions, pedestrians no longer view other pedestrians as harmless passersby's but as potential threats of exposure to COVID-19. Results from Phase I indicate that a small portion of respondents do not wear masks when outdoors (8.7%) despite regional recommendations to do so; however, in Phase II, all participants interviewed indicated measures taken to ensure social distancing from others when walking in public, whether wearing masks or not. Some examples of this decision-making include always looking for escape routes while walking and stepping off the walking path to create distance from others.

Table 8 presents a summary of other-focused statements and associated other-focused rules for dynamic decision-making. Figure 20 illustrates the other-focused dynamic decision-making process.

Table 8. Decision Statements and the resulting dynamic rules when focusing on others.

Decision Statement →	"Other" Rules
1. What is this person going to do next in this situation?	Decide action based on the behaviour of the other pedestrian
2. When I am walking in a neighbourhood, I step off the path for groups or elderly persons.	Step off walking path to create social distance from groups or elderly persons when walking in a neighbourhood
3. While walking, I always look for escape routes	Look for escape routes to maintain social distance while walking
4. Strangers are 'riskier' to be around than known others	Be more cautious when walking around strangers.
5. Crowded areas are risky, and more caution has to be taken in these locations	Take more caution when walking in crowded areas
6. I am cautious around those I feel are vulnerable	Be more cautious when near vulnerable persons
7. Would it be rude to 'call-out' persons in public who are not distancing?	Do not confront others that are not following social distancing guidelines.
8. I naturally create distance from others because of my dogs (pre and during COVID-19)	Create social distance from others when walking with dogs.
9. Walking on someone's private property to create distance is uncomfortable	Only walk on private property to social distance if unavoidable
10. Standing back from others when room is available	Stand away from others to create social distance when possible
11. When other people get too close to me, I try to walk around them	When other persons get close, walk around them to create social distance.
12. Stepping off of my walking path is the easiest way to create distance quickly	Step off the walking path to create social distance quickly.
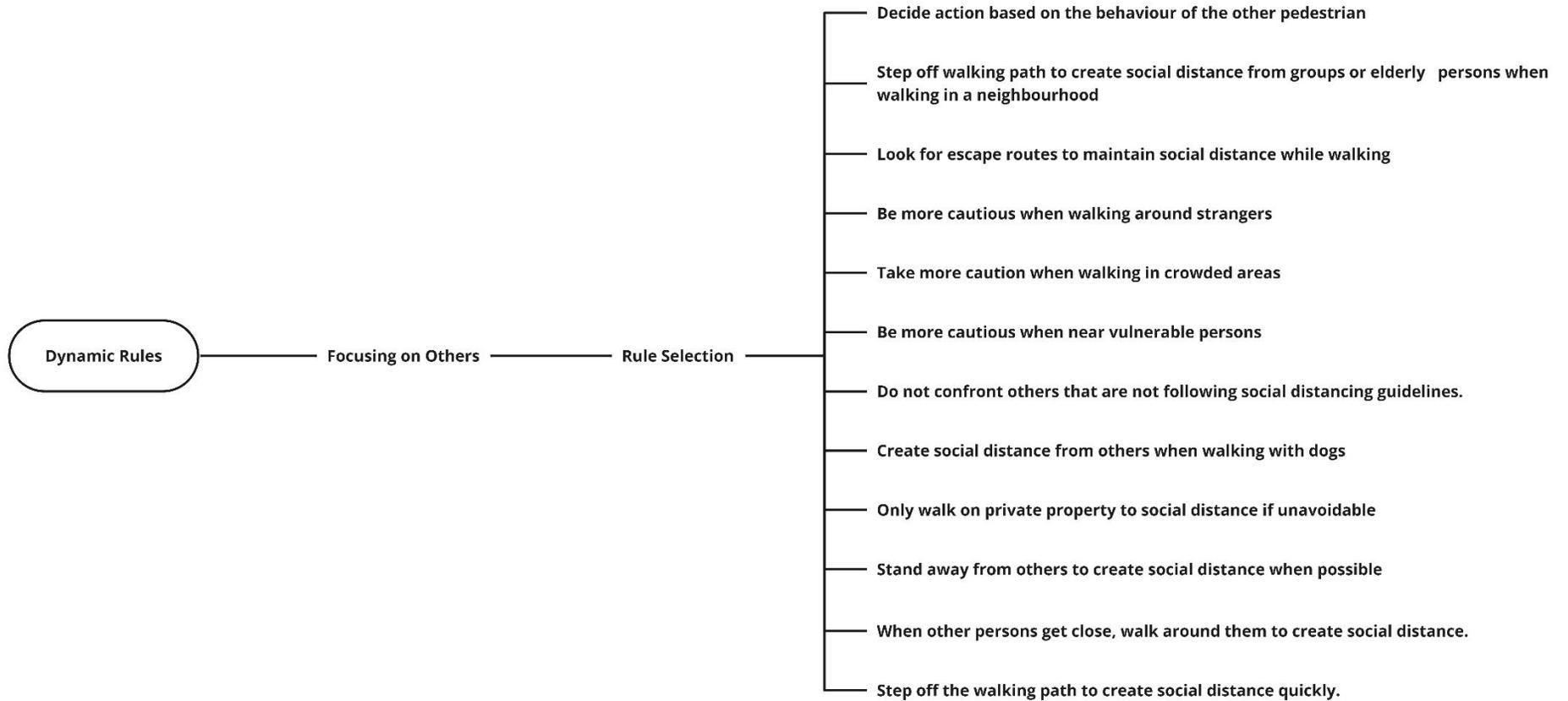
Figure 20. Diagram of pedestrian dynamic rule selection when focusing on others.

6.4.3 Distancing Guide: Rules and Guidelines

The rules presented in Figure 20 (Section 6.3.2) represent specific strategies that pedestrians are using to gauge an appropriate (6ft/2m) distance between other pedestrians. Using markers on the ground is not common or always possible. For example, it was mentioned during interviews (2, 4, 5, 6, 7, 8) that social distancing aids or reminders are absent in most common walking locations, (e.g., suburban areas or downtown), so pedestrians are relying on memory based on indoor shopping experiences (e.g.., distancing markers in stores) or other methods to gauge distances between others (e.g., length of a dog leash). Adding in more markers on the ground is not necessarily the solution. Two participants indicated that in situations where there are markers on the ground it is not always intuitive to look down while walking because looking down at the ground is not a natural habit when walking. Similarly, when asked to rate visual aids (See Table 6), survey respondents ranked markers on the ground as the least helpful in helping them to gauge distances between others. Therefore, it is not surprising to see participants indicating methods such as using their previous knowledge of their own or their partner's height when laying down or a dog leash to estimate 6ft/2m. One participant indicated a choice of "overexaggerating" how far they believed was appropriate to distance to be safe. Having alternative cues or memory aids for gauging social distancing t may be valuable in public walking situations. Table 9 presents a summary of statements and associated social-distancing rules for dynamic decision-making. Figure 21 illustrates the dynamic social-distancing decision-making process.

Table 9. Decision Statements and the resulting dynamic rules when creating social distance.

Decision Statement →	"Distancing" Rules
1. Looking down at floor stickers not intuitive	Visual markers on the ground are not helpful.
2. I use my dog's leash to gauge a 6 ft distance	To create social distance, use a dog leash
3. Uses visual markers on the ground to 'remember' distance	Visual markers on the ground are helpful to visualize the correct social distance
4. If not many cars are present, it is okay to walk in the street/road to avoid others	To create social distance, walk in the road to avoid others
5. Uses personal height to gauge appropriate distance	Use personal height to measure social distance
6. I [overexaggerate] how far I need to distance	To create social distance, move farther away than necessary
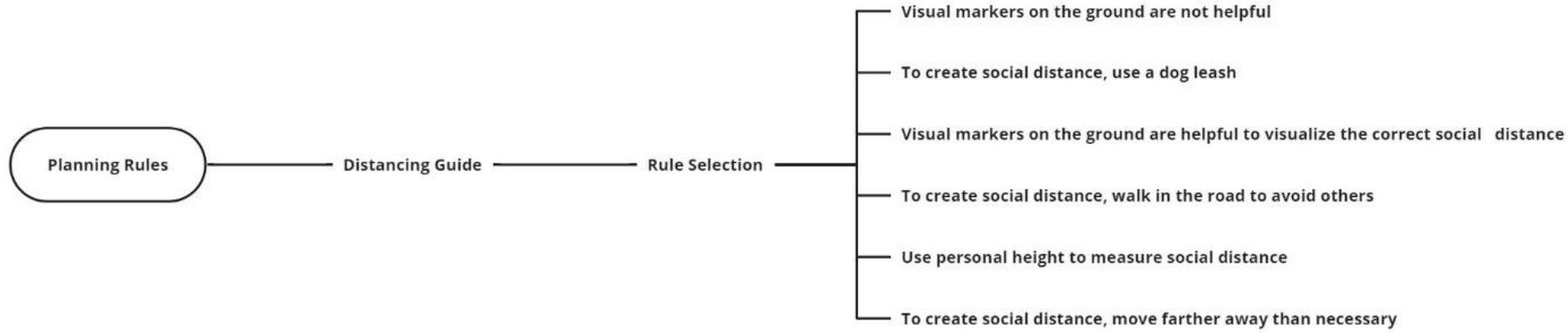
Figure 21. Diagram of pedestrian dynamic rule selection when creating social distance.

6.5 General Safety Rules

General Safety rules tend to be used both before and during walking in public. Compared to the other main categories of rules (Dynamic, and Planning and Expectations), General Safety rules are more flexible in their use by pedestrians (see Figure 22). They tend not to be as specific as the other rules but are guidelines that pedestrians may be mindful of both before and during a walk. These rules are also focused on being around others, in busy or crowded areas and distancing navigation. For example, 'Avoid busy streets to reduce stress" is referenced in situations both in walk planning and during a walk itself, in which some participants (25%) indicate a reluctance to be in public areas with lots of persons or heavy vehicular traffic. During interviews, we found that behaviours or feelings that fit into this category were given as explanations as to why certain things are done. Two of the eight (25%) participants indicated that anyone outside of their personal home was 'risky'. Table 10 presents a summary of statements and associated general safety rules for pedestrian decision-making. Figure 22 illustrates the general safety decision-making process.

Table 10. Decision Statements and the resulting General Safety rules. These rules may be applied before and/or during a walk.

Decision Statement →	"General Safety" Rules
1. Walking on a busy street is stressful	Avoid busy streets to reduce stress.
2. Anyone outside of the home is 'risky.'	Avoid walking around strangers to reduce risk.
3. Walking on busy streets means being creative and taking more risks	When walking on a busy street, creativity must be employed
4. Indoor navigation not always easy to follow	When walking indoors, one must be more cautious
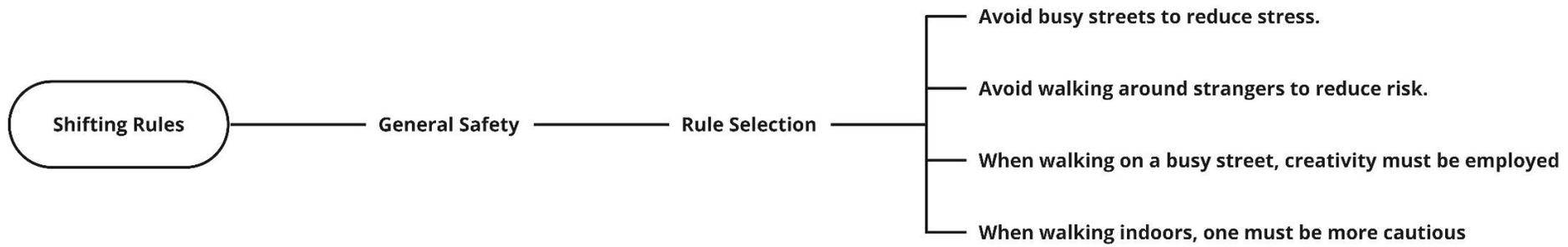
Figure 22. Diagram of pedestrian rule selection when focusing on general safety.

6.6 Planning and Expectations

Planning and Expectation rules are used by pedestrians prior to going on a walk. These rules determine parameters of the walk like where, when, and how the walk will take place (see Figure 23). The rules discovered can be grouped into two sub-categories, "COVID-19 related" and "personal safety & preferences." Both are related to personal safety and risk aversion when walking in public.
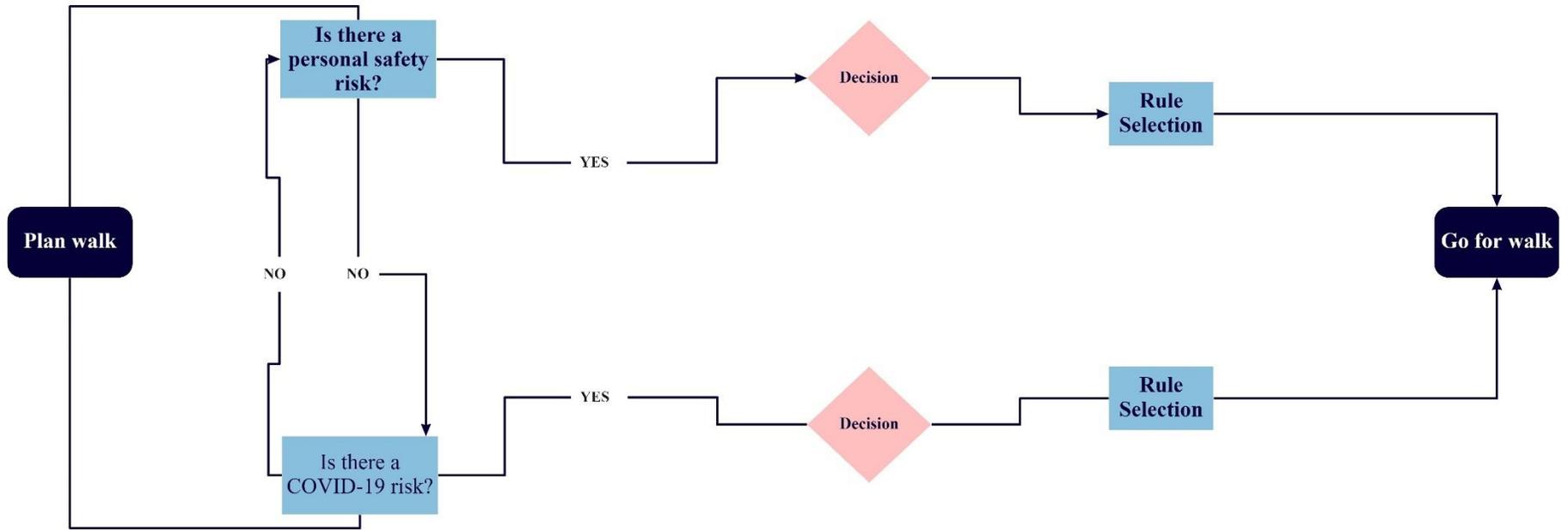
Figure 23. Diagram of the emerging planning & expectation pedestrian rule selection process. This rule selection process is divided into two

classifications:1. A focus on personal safety & preferences, and 2. A focus on COVID-19 risks.

6.6.1 Personal Safety & Preference: Rules and Guidelines

The rules within this category are used by pedestrians to plan out their walks without a specific emphasis on COVID-19 (see Figure 24). Despite not specifically mentioning COVID-19 it is likely that the pandemic conditions have an underlying influence on rule formation and interpretation for action. Participants mention walking locations that feel safer, walking times that are safer, weather conditions that are preferable to walk in, and the enjoyment factor of certain locations. Like the COVID-19-related rules category, the Personal Safety & Preferences rules align with the themes extracted during the thematic analysis of walking frequency open-ended comments in Phase 1. It is interesting to note that six of the eight interviewed participants made comments that indicated adherence to the expectation 'Crowded areas are risky, and more caution has to be taken in these locations'. This aligns with other data collected throughout Phase I and Phase II in which respondents and participants commenting about walking frequency made mention of crowded areas being risky and a desire to avoid these areas when possible. Therefore, it makes sense that personal safety would be a rule used by pedestrians to govern walking locations, times and/or days. Table 11 presents a summary of statements and associated Personal Safety & Preference rules for pedestrian planning and expectation. Figure 24 illustrates decision-making process for selecting Personal Safety & Expectations rules.

Table 11. Decision statements and the resulting planning & expectation rules for Personal Safety & Preference.

Decision Statement →	"Personal Safety & Expectation" Rule
1. Walks on busy streets not as enjoyable	Avoid walking on busy streets, unless necessary
2. I only go downtown for essential reasons	Avoid walking downtown except for an essential reason
3. Walking in a suburban area is safer than walking a trail	Go for walks in suburban areas for a safer experience
4. I have to pay more attention when walking compared to when I cycle	Walking requires more attentiveness than cycling
5. Weather dictates walking behaviour	Go for walks when it is cool outside.
6. Feels that going to the salon early will mean fewer people to avoid	Avoid others by going to public places early.
7. walking is now more of a pastime than a means to an end	Walking is done for pleasure.
8. Public places are more crowded on the weekends	Avoid public places on the weekends
9. Walking in the early morning is safer	Avoid walking after the morning
10. I go for groceries and shopping at times of day that I consider quiet to avoid crowds	Avoid crowds by shopping during quiet times of the day.
11. I have to plan my actions outdoor now	Outdoor walking requires planning
12. Walking in a neighbourhood (suburban area) is safer than walking near a busy street (intersection)	To ensure safety, walk in suburban neighbourhoods.
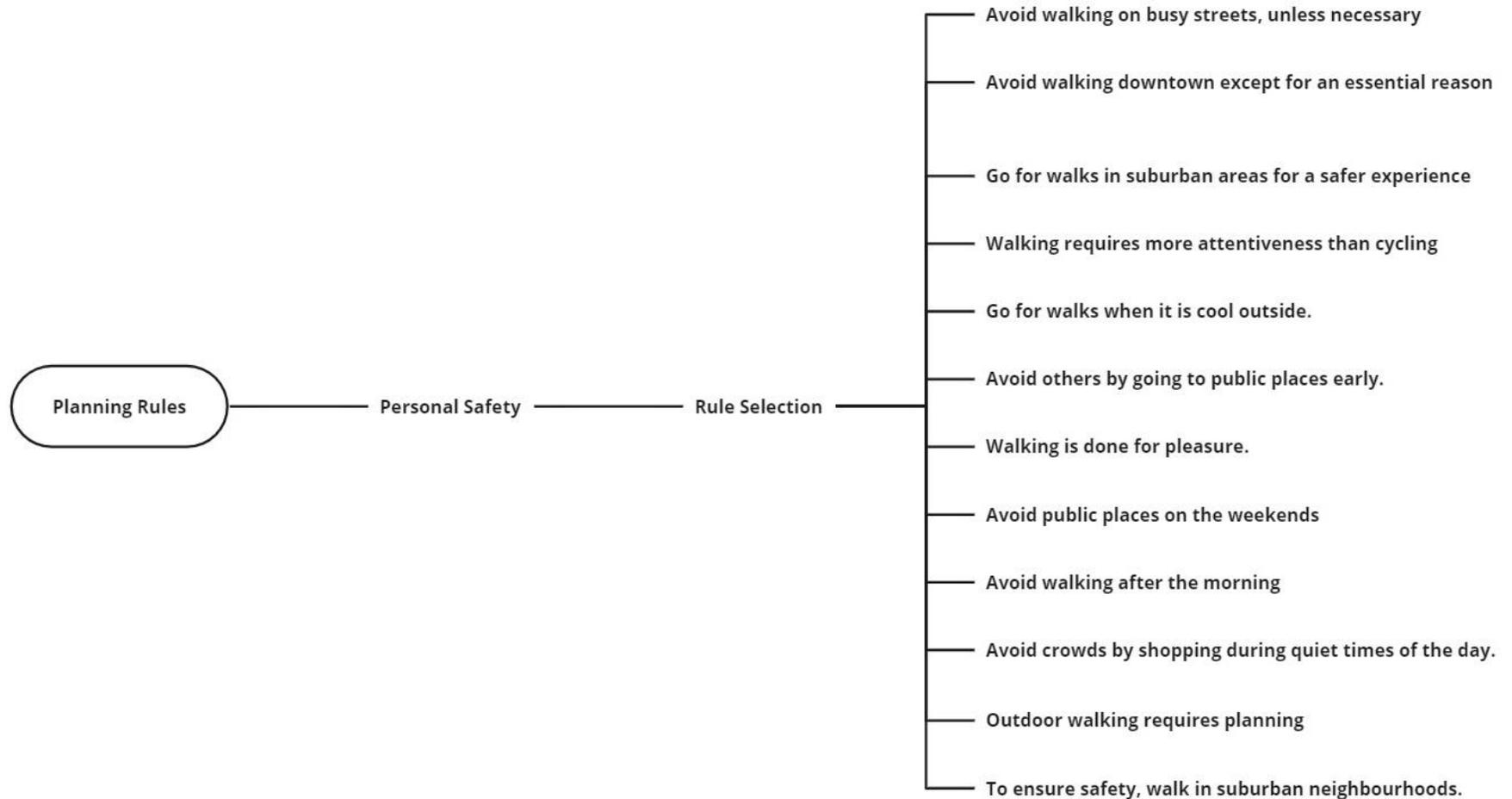
Figure 24. Diagram of pedestrian walk planning rule selection when focusing on personal safety.

6.6.2 COVID-19: Rules and Guidelines for Social Distancing

The rules within this category are those in which participants and respondents specifically indicated COVID-19 as their reasoning for using them (see Figure 25), which contrasts with the more general personal safety & preference rules. The rules in this category focus on the ease or difficulty of social distancing from others, wearing a mask, risk of exposure to COVID-19 and limiting trips to specific places (e.g., store, bus, crowded areas). As a set of pedestrian decision-making rules, this new category of rules would have been created in response to social distancing measures. The general focus areas of this category is like themes seen in the thematic analysis of Phase I responses relating to walking frequency, which should not be surprising given that the Phase II participants were also respondents in Phase I. Examples of personal safety and preference themes include 'weather being a determining factor in going out for a walk' (Phase I) and 'weather dictating walking behaviour' (Phase II); 'only going out when necessary' (Phase I) and 'I only go downtown for essential reasons (Phase 1)'. It makes sense that walking frequency would play a role in Planning & Expectation rules before and during the COVID-19 pandemic, especially for social distancing. Table 12 presents a summary of statements and associated COVID-19 Social Distancing rules for pedestrian planning and expectation. Figure 25 illustrates decision-making process for selecting COVID-19 Social Distancing rules.

Table 12. Decision statements and the resulting rules for COVID-19 Social Distancing.

Decision Statement→	"Social Distancing" Rules
1. Expects that trail walking paths have enough room to distance	To create social distance on a walking trail, step to the edge of the path.
2. I am more comfortable walking in areas that I believe have sufficient space to distance from others	Walk in areas with lots of space manoeuvre
3. I am more comfortable walking in a park compared to other 'trail' settings	To create social distance in a park, walk onto the green space.
4. Walking in a neighbourhood is safe	To create social distance in a neighbourhood, step off of the walking path
5. I have health conditions, so I don't go inside stores	Avoid going into stores to reduce the risk of exposure to COVID-19.
6. Taking public transit is no longer safe and will increase exposure risk	Avoid public transit to reduce the risk of exposure to COVID-19
7. I no longer walk at a trail near the unis because it makes me uncomfortable	Avoid walking in trails in order to avoid crowds.
8. Avoids quick trips	Grocery shopping is only done once a week.
9. A mask is not needed when going for a walk outdoors	Do not wear a mask when walking outdoors.
10. I wear a mask indoors	Wear a mask when in public, indoor spaces
11. Chooses to gauge distance with walking partner(s) before starting a walk	Gauge social distance with a walking partner before the walk.
12. Easy to distance in parks (not including trails that run through, i.e., Laurel Trail)	Walk on trails to avoid others.
13. All of my body must be covered when going in public in order to be safe	Cover the entire body to reduce the risk of exposure to COVID-19.
14. more measures implemented makes me feel safer	Going in public is safe with increased measures in place.
15. Wears a mask when going to a store	Wear a mask when in public, indoor spaces
16. Crowded areas are risky, and more caution has to be taken in these locations	Avoid crowded areas to reduce the risk of exposure to COVID-19
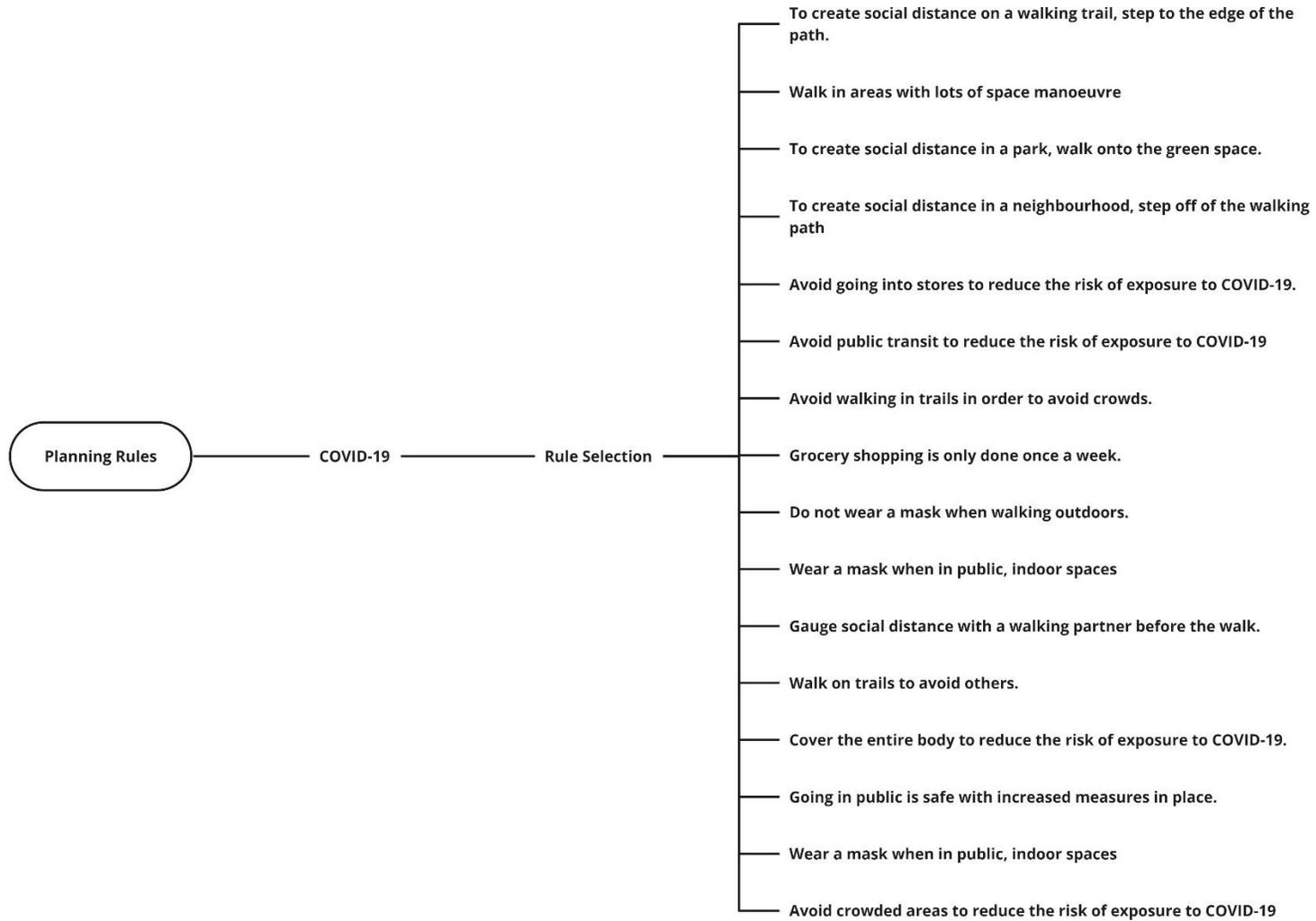
Figure 25. Diagram of pedestrian walk planning rule selection when focusing on COVID-19 Social Distancing.

Chapter 7
Applications of Emerging Pedestrian Rules

7.1 Applying Pedestrian Rules

The combined results of Phase I and II indicate that pedestrians are now using new or modified rules to govern their public walking experiences under pandemic conditions. The new rules can be split into two main categories: 1. rules and expectations used prior to walking that control the walk planning and preparation phase; and 2. rules that are used in an ongoing or dynamic way when out in public and navigating around other pedestrians. When walking, pedestrians select and apply rules that reflect their mental model of how to maintain social distancing to avoid transmitting or acquiring the COVID-19 virus. Given the anticipation that it will take a number of months, possibly years, to eradicate COVID-19 globally (Miller, 2020; Powell, 2020; Scudellari, 2020), further consideration of the emerging pedestrian rules suggests a need for changes to infrastructure (e.g., widening of pedestrian pathways) and a need for education to promote the more effective rules for maintaining social distancing.

7.2 Emerging Pedestrian Rules and Need for Infrastructure

In seven (7) of the ten (10) scenarios presented, the most selected response was to step off the path or sidewalk to maintain social distancing. In two (2) of the presented scenarios (SD4 and SD10), most respondents chose just to stop moving, and in one (1) scenario (SD9), respondents chose to continue their path or make no change. It is possible that a strong preference or need to step off the current walkway indicates that current infrastructure is not suitable for pedestrians to travel without the need to constantly be on the lookout for an escape route. It is possible that self-reports of choosing to step off the walking path may not reflect the true actions taken in the scenarios presented and may indicate the action that respondents believe should be taken. Even if this is the case, it points to a need for pedestrian countermeasures or guidelines that encourage the utilization of available space in order to maintain social distancing. In future studies, including controlled observational research methods such as augmented reality or environments, may confirm that real-time actions match self-reports. It is worth noting that locations of future studies may contribute to variations in emerging pedestrian rules when taking into account cultural norms and ideals, local laws, transportation methods and infrastructure in place.

As previously mentioned, the presence of a 'vulnerable' may have pedestrians exercise more caution by choosing to stop walking and give right of way to the other pedestrians (e.g., SD4 had respondents walking with a baby stroller). The presence of a group of pedestrians versus a single pedestrian also seems to

contribute to the decisions made by respondents. Within SD10, the scenario presented had more characters and complexities than the previous nine scenarios, such that respondents commonly mentioned how they would use the space available to best navigate the situation presented. The only scenario (SD9) in which no change was chosen by most respondents was one in which the closest other person in the scenario was on their own property, and this was likely perceived as a 'low-risk' scenario.

Respondents relying on "step off the path" as the main rule for guiding social distancing points to a limitation in the current infrastructure within the region, particularly in the most heavily walked areas (i.e., downtown, parks/trails and suburban areas). Older neighbourhoods tend to have "traditional" sidewalks that are 1.5m wide (T. C. of Waterloo, 2013), which are an insufficient width to allow pedestrians to pass one another while maintaining the recommended social distancing. There is a need for sidewalks that are wide enough or have sufficient greenspace adjacent to walking paths to allow for easier distancing. The Region of Waterloo, Ontario, promotes an active lifestyle and encourages walking and cycling for its residents. As a step in this direction, Waterloo Region recently implemented programs to encourage residents to participate in its active transportation campaign ("Active Transportation," 2020). These initiatives include a bike pilot project which was implemented during Spring and Summer 2020 (Region of Waterloo, 2020; "Separated bike lane pilot," 2020)**,**; and shared spaces which were converted to allow for persons to walk and enjoy wider streets (Nielsen, 2020; Thomson, 2020). The programs encourage residents to get out more and allowed for easier movement and distancing between pedestrians in public. Local businesses benefited as people were to remain longer in the outdoor spaces near commercial areas. Traffic calming measures, such as residential roads blocked to local traffic only, were piloted in residential neighbourhoods to limit non-local vehicular traffic and allow for more space within the road for pedestrians and cyclists to utilize. Although not the intended purpose, streets that were a part of the bike pilot program were welcomed by pedestrians, and some participants noted that the presence of bike lanes allowed for easier social distancing compared to streets or sidewalks with no adjacent bicycle lanes. Therefore, the benefits of bike lanes should be considered beyond their original purpose. This also signals the benefits of multipurpose pathways to allow safer pedestrian activities without the need to "step off the path.".

7.2.1 Emerging Pedestrian Rules and Need for Education

Although mentioned briefly, some pedestrians reported confusion around social distancing and mask use due to inconsistent information being distributed to the public. For example, mask wearing was first discouraged or deemed unnecessary (Howard, 2020), and now mask wearing is strongly encouraged ("Coronavirus disease (COVID-19) advice for the public: When and how to use masks," 2020). Conflicting public messages adds an element of distrust between experts/authorities and the public and may foster

unwillingness to follow future recommendations. As general health advice continues to change as new research developments become available, trust in public health messaging may continue to be a growing concern. Public health officials had previously defined "close contact" as being within six feet of someone infected with COVID-19 for an exposure time of 15 minutes, either at one time or cumulatively (Centers for Disease Control and Prevention (CDC), 2020). Recently, new research has revealed that exposure of fewer than fifteen minutes and a distance of up to 20 feet may result in infectious exposure to COVID-19 (Kwon et al., 2020). These time and distance limits are given, whether masks are worn by all parties or not. Being mindful of this, pedestrians must now weigh the risks of stepping into the roadway to maintain social distancing or being exposed when walking past other pedestrians, for any length of time or distance.

Another emerging issue seen from participants was the inability to consistently judge maintaining six (6) ft. / two (2) m away from others when in public spaces. Available signage, markers, and aids in some public spaces and highly trafficked areas appear insufficient to assist with judging appropriate social distances. Contributing factors may include lack of signage in some walking locations, signage undetected due to placement within an environment, and signage unreadable readable due to weather or lighting conditions. Without aids pedestrians are forced to rely on distancing further than necessary, relying on memory or using personal visualization methods such height of someone familiar, shopping cart distance or dog leash length. The self-reports of pedestrians suggest that providing the public with additional methods for judging appropriate distances would be helpful in adhering to social distancing guidelines. When ranking distancing aids from most helpful to least, most respondents ranked a sign posted on a pole as most helpful and ranked a marker on the ground as least helpful. Although overall, there was not a large difference between the rankings of all the aids shown, it suggests that the placement of 'traffic signs for pedestrians" as reminders may be of assistance. Not only are pedestrians familiar with road signage, but the signs would be placed at a typical eye level and visible to pedestrians through all seasons compared to having to look down while walking to see cues painted on sidewalks or paths.

7.3 Recommendations

Based on the results of this study, recommendations for improvements to the pedestrian experience primarily come from two perspectives: infrastructure adjustments and public education.

7.3.1 Infrastructure

An overall theme uncovered from thematic analysis of the survey open-ended responses (Phase I) and interviews (Phase II) was the need for more space for pedestrians to manoeuvre; and that inadequate physical infrastructure contributed to the decrease or resistance to walking in public spaces since March

2020. An obvious recommendation would be the implementation of additional usable space for pedestrians, such as wider sidewalks and multipurpose areas that allow for spaces to be used for pedestrians, cyclists, and persons to sit down. When implemented in other locations, wider sidewalks have been found to increase pedestrian walking speeds, with an inverse for smaller land areas (Rastogi, Thaniarasu, & Chandra, 2011).

For the Region of Waterloo, the recommendation could mean continuing safe street space initiatives piloted during the summer of 2020. Specific initiatives include the conversion of a few urban street spaces from being vehicular focused to ones used for community enjoyment, walking, and cycling. Future research should look at the infrastructure available in other urban locations that would make it more feasible for pedestrians, vehicles, and cyclists to co-exist safely and comfortably.

Restructured urban areas redesigned to promote safe cycling and walking with social distancing, may have the added benefit of 'green' or sustainable environments as well (Barbarossa, 2020). The Waterloo Region has noted the environmental benefits that could be realized with its Active Transportation initiatives (discussed in Section 2.5). Similar to successful strategies reported by Barbarossa (2020), a focus on shifting urban infrastructure from a motorized vehicle-based plan to one more 'person' focused will be crucial in any pedestrian-friendly solution. Using a case study approach, Barbarossa (2020) analyzed urban mobility projects undertaken in 10 metropolitan Italian cities whose governing bodies were trying to increase space for cycling and pedestrians in response to COVID-19 conditions. Urban projects that benefited the environment and helped improve active transportation included measures such as temporary and permanent bike lanes, incentives to purchase non-motorized means of transportation, additional areas for pedestrian access, sharing mobility programs, traffic calming measures, and public space renewals creating more space for people to spread out while navigating. A common theme among all the solutions and strategies implemented is the need for a change in the 'typical' urban planning and layout of cities and a shift to a more 'person' focused strategy with less emphasis on cars.

With any proposed solution to be implemented, proper planning and research must be done to ensure feasibility and appropriateness to the problem(s) being solved. In the case of the Region of Waterloo, proposed solutions must be appropriate to the nuances of the region and not just replicated blindly based on the actions taken by other jurisdictions. In addition, planners must work with stakeholder to consider the desired benefits relative to costs and resources. Other aspects to consider include time to completion for construction, impact on businesses in the area, environmental impact, and the expected use rate of the facilities. To correctly identify which solutions would be best for pedestrians in Waterloo Region, feasibility, approaches such as case studies, pilot programs and public surveys would be necessary.

7.3.2 Public Education

Public education and information dissemination related to COVID-19 is another area that may benefit from improved strategies. Educational strategies may include increased exposure to key message through a variety of public communication channels (e.g., local news stations, social media); ensuring consistent messages across communication channels; promoting the use of more personal visualization strategies for pedestrians to use when out in various public settings. An improved public educational strategy may benefit the public reception of information regarding COVID-19, as well as information regarding COVID-19 vaccinations.

Since posted pedestrian signage was preferred as a countermeasure, having pedestrian, and cycling signage systems designed similar to road signage should also be explored. Visual aids on the ground are not always sufficient or helpful. Where aids are lacking or not practical, Pedestrians need a way to visualize an acceptable social distance gap quickly and easily. It is recommended that a public education campaign be created that includes common and convenient ways for pedestrians to recognize appropriate physical space to leave between themselves and others. Being able to better judge physical distance without the need for a ground-based measuring aid will be helpful in situations where markers on the ground have faded and are no longer visible, in times of inclement weather such as heavy snow in which markers would be covered, and to aid pedestrians who do not or cannot look down even if markers or aids are present. Leaning on personal understandings as an efficient and intuitive way to gauge distance was commonly reported during interviews. Thus, existing countermeasures for social distancing, such as ground-based markers, should be supplemented with public education on visualizing familiar things to gauge social distance.

Chapter 8

Limitations, Contributions, and Future Work

8.1 Limitations of Methods Used

Pedestrians awareness of risk associated with different walking situations has increased, including COVID-19 transmission risk in crowded areas, locations with limited green space, and public transit. Differences in the decision-making process of pedestrians for a variety of walking scenarios were examined using a mix-method approach combining a customized pedestrian survey (Phase I) and semi-structured interviews (Phase II). Thematic analysis provided insight into the impact that the COVID-19 pandemic conditions have had on pedestrian mental models, and the emerging rules that pedestrians are using to maintain social distancing while walking in public.

As with any research, there are limitations with the methods used. The study was conducted solely within the Waterloo Region, and because of this, the results found may have limited generalizability to other jurisdictions without further research. Survey results may be relevant to other locations that are nearby or similar to Waterloo Region as it relates to local infrastructure, population characteristics and social distancing measures. Nevertheless, the results of the thematic analysis used to identify categories of pedestrian rules for social distance decision-making are likely to be transferable to a wider range of communities as they include basic rules for planning & expectations, as well as dynamic rules for adjusting social distancing strategies while walking.

The study utilized convenience sampling and an online distribution process. At the time of data collection, no in-person survey distribution was permitted, and this meant that only those with internet access were able to participate. As a result of the recruitment method used, some demographic groups may have been more likely to respond than others. Despite this, the demographics of survey respondents were distributed similar to that of the Region of Waterloo adult population.

It is important to note the time frame in which this study took place (July-August 2020). Weather can have an impact on walking experience. During summer months, most pedestrians find it easier to walk outside. During the winter, pedestrians must navigate around the usual road environment, and must adapt to changing road conditions, visibility, and the presence of plowed snow around roads and sidewalks. All of these mean a smaller amount of space for pedestrians to navigate, and possibly new 'rules' must be created during these times. For example, a few rules that may differ would include seasonal use of markers on the

ground to judge an appropriate distance, exaggerating the distance needed to social distance, and the decision to stop moving to allow others to move around. In conditions that have low visibility or lack available space, adhering to even basic social distancing rules may prove difficult. It is strongly recommended that this study be replicated for different weather conditions and regional locations. This would help to validate the approached used in this study and position the findings in relation to other locations within Canada.

Finally, data collection for this study took place approximately four months after the onset of the pandemic and during a time when stay-at-home restrictions within the region had begun to be relaxed (Hill, 2020). At the time of writing this document, the COVID-19 pandemic has been ongoing for almost one year. Recently, it was announced the entire province of Ontario would be entering a 28-day lockdown, beginning December 26, 2020 (Rocca, 2020). The Province has created the 'Keeping Ontario Safe and Open Framework,' a new colour zone system to help with regulating what businesses are allowed to be open within regions (Public Health Ontario, 2020), It is possible that rerunning the study, both survey and interview phases, would reflect further shift in mindset about safety and walking outdoors due to rise in COVID-19 cases and related deaths (Banger, 2020b, 2020a), mental fatigue (Matias, Dominski, & Marks, 2020) and changes in personal economic circumstances.
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8.2 Summary of Contributions

The goal of this research study was twofold, in providing an understanding of the decision-making changes that are occurring because of social distancing measures implemented, and a pilot study determining the feasibility of a survey and semi-structured interview methodologies to be used for the development of pedestrian mental models. This research study contributes four key outcomes as it relates to developing pedestrian mental models and the understanding of the impact of COVID-19 and social distancing on adult pedestrian behaviours:

1. Used a mixed-method approach combining data analysis from a survey and semi-structured interviews to identify pedestrian mental models and emerging rules for social distancing while walking outside.
2. Explored the motivations behind adjustments to adult pedestrian walking habits due to COVID-19 pandemic conditions. Pedestrians are now more cautious when walking in crowded public places as well as when encountering others in public.

3. Recognize that different actions taken by pedestrians in varying settings are dependent on the available infrastructure. When there is low traffic and lots of greenspace, pedestrians are inclined to step off their walking path as a social distancing strategy. In contrast, when traffic is higher or available greenspace is low pedestrians are more inclined to accept higher risk levels, look for escape routes or communicate with the other pedestrians as a way to maintain social distance.

4. Ground-based markers to indicate social distance gaps are insufficient. Needed are public education campaigns to train personal visualization strategies for dynamically gauging appropriate social distancing.

8.3 Future Work

Expanding the research to look at other locations within Ontario and Canada would be beneficial. The province of Ontario has reported some of the highest COVID-19 cases to date; however, this is not the case in other provinces, including Prince Edward Island, Nova Scotia, New Brunswick, Newfoundland and Labrador, Manitoba, Saskatchewan, Yukon and the Northwest Territories (Canada), 2021). A study examining the behaviour of pedestrians in these locations with low COVID-19 case numbers may have different results than those found in the Waterloo Region. It is possible that pedestrians in low-case regions take a different approach to social distancing as they view the risks differently.

It would be helpful for similar studies to be conducted during other seasons and weather conditions, as it is likely pedestrians would have different actions and approaches to social distancing in winter months when compared to summer months. A common rule in this study was that of stepping off the current walking path; however, in conditions or locations where this is not possible, pedestrians must take a different approach in their attempts to maintain social distance. During harsh winter conditions, it is expected that the frequency of walking will change due to the availability of safe walking paths. This may lead to differing pedestrian rules than those seen in this study. For example, walking may be difficult for pedestrians choosing to walk in the road to create distance because plowed snow adjacent to walking paths or icy conditions makes it difficult to step off the path to accommodate another pedestrian.

It would be valuable for this study to be replicated within other regions, including the United States and outside of North America. Globally, governing bodies have taken different approaches to control the spread of COVID-19. Government approaches can affect public attitudes towards the risk factors associated with disease transmission and need for social distancing. \Other factors that may impact pedestrian mental models and rules include modes of transportation available, population density, and differing infrastructure.

The expansion of this study to other locations within Canada and globally would expand understanding of the social distancing actions of pedestrians in different locations, as well as support the use of a mixed-method approach for mental model creation.

In summary, this thesis research study provides insights into the advantages and limitations of a survey questionnaire and semi-structured interviews in the formation of pedestrian mental models and identification of pedestrian rules used for planning and dynamic decisions. Overall, this thesis contributes to the body of research available regarding the adult pedestrian experience and pedestrian mental models, especially under pandemic conditions requiring social distancing.

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UNIVERSITY OF
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INFORMATION SHEET FOR PARTICIPANTS

Title of the project; Understanding pedestrian decision-making during the Covid-19 pandemic

Team members:

Carolyn MacGregor, PhD   **Georgette Greenslade**

Associate Professor   MASc Candidate

Department of   Department of

Systems Design Engineering   Systems Design Engineering

University of Waterloo   University of Waterloo

Email: **cgmacgre@uwaterloo.ca**   Email:**gegreens@uwaterloo.ca**

Phone: 519-888-4567 x32897

Purpose of the Study: You are invited to participate in this survey as part of our research study titled, '*Understanding pedestrian decision-making during the Covid-19 pandemic'* at the University of Waterloo. The COVID-19 pandemic raises interesting challenges for pedestrians. On the one hand, Canadian citizens are advised to remain at home and away from others as much as possible; and yet we are also encouraged by health officials to go for a walk for wellness while maintaining social distancing requirements (e.g., stay 6 feet apart). This study will explore how pedestrians are starting to build new "rules" for how to keep social distancing gaps between themselves and other pedestrians while walking in public spaces (e.g., sidewalks, pedestrian paths, parks). Understanding how pedestrians are currently making decisions about social distancing while walking is an important step for identifying effective ways to educate and design our walking environments for health and safety.

Procedure: Should you choose to participate, you will be asked to agree to the terms and give your consent before beginning the survey. During the survey, you will be asked questions relating to your experiences as a pedestrian both prior to and during social distancing. These questions range from what you do or might do in general situations to how you might react in specific scenarios. Social distancing is new for all of us. There are no right or wrong answers. We are interested in your walking activities and thoughts about being a pedestrian. The survey, consisting of a combination of yes/no and multiple-choice questions, should take about 10-15 minutes to complete.

Participation criteria:

Adults (18 years and older) currently residing in the Region of Waterloo, which includes Waterloo, Kitchener, Cambridge, and the affiliated townships. We are restricting to the Waterloo Region so that we have a reasonable understanding of the general walking environments of our respondents.

Your rights as a participant:

Your participation is voluntary; you are free to skip any questions that you do not wish to answer and/or those that make you uncomfortable. You are free to withdraw your participation at any time without any penalty by exiting the survey and/or closing your internet browser window.

Confidentiality:

You will be completing the study by an online survey operated by Qualtrics Online Surveys. When information is transmitted over the internet privacy cannot be guaranteed. There is always a risk your responses may be intercepted by a third party (e.g., government agencies, hackers). Qualtrics Online Surveys temporarily collects your ID and computer IP address to avoid duplicate responses in the dataset but will not collect information that could identify you personally. The data captured will be stored on a secure password-protected server accessible only by the researchers. No identifiable information will be collected during this study so that individual participant's anonymity will be protected. Your data may be included in a dataset that is open to academic researchers. Data will be de-identified (i.e., data such as names and identifying demographic information will be removed) prior to submission to the database and will be presented in aggregate form in online publications. This is integral to the research process as it allows other researchers to verify results and avoid duplicating research.

Remuneration: In appreciation of the time, you have given to this study, you can enter your name into a draw for 1 of 4 prizes. The prizes include four gift cards, worth $25 each, for local businesses in the Region of Waterloo. Your odds of winning one of the prizes is based on the number of individuals who participate in the study. We expect that approximately 400 individuals will take part in the study. Completion of the survey is not required and clicking through to the end of the survey can be done to enter the draw. Information collected to draw for the prizes will not be linked to the study data in any way, and this identifying information will be stored separately, then destroyed after the prizes have been provided. The amount received is taxable. It is your responsibility to report this amount for income tax purposes.

Benefits of the study: Participation in the study may not provide any personal benefit to you but the study will benefit the community. Given the current Covid-19 pandemic we are experiencing, it is important to understand pedestrians' thought and decision-making processes in order to make recommendations to better design environments and educational guidance for social distancing in public spaces.

Acknowledgment: This study is funded in part through a Faculty Research Fund held by the supervisor at the University of Waterloo.

Contact Information: This study has been reviewed and received ethics clearance through the University of Waterloo Research Ethics Committee ORE #42014. If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca. For all other questions, or any questions regarding participation in this study, please feel free to email the researchers. In case of additional questions at a later time, please contact Georgette Greenslade (MASc student) or Carolyn MacGregor (Supervisor).

Thank you for considering participation in this study.

Survey

Appendix B

Questions that were modified for pedestrian social distancing survey

Positive Behaviours
- When I am accompanied by other pedestrians, I walk in single file on narrow pavements so as not to get too close to other pedestrians
- I walk on the right-hand side of the pavement so as to not bother the pedestrians I meet

Errors
- I cross even if vehicles are coming because I think they will stop for me
- I walk on cycling paths when I could walk on the pavement, in order to avoid being too close to other pedestrians
- I run across the street without looking because I am in a hurry to avoid other pedestrians or cyclists

Violations
- I cross diagonally to save time
- I cross outside the pedestrian crossing even if there is one (e.g., a crosswalk or zebra crossing) less than 50m away to create distance between other pedestrians or cyclists
- I take passageways forbidden to pedestrians to save time avoid meeting other pedestrians or cyclists on my walk

Aggressive Behaviours

- I get angry with another road user (pedestrian, driver, cyclist, etc.), and I yell at them
- I cross very slowly to annoy a driver
- I get angry with another road user (pedestrian, driver, cyclist, etc.), and I make a hand gesture

Lapses

- I realize that I have crossed several streets and intersections without paying attention to traffic
- I forget to look before crossing because I am thinking about something else
- I cross without looking because I am talking with someone
- I forget to look before crossing because I want to join someone on the pavement on the other side
- While walking, I engage in other activities (e.g., talking, listening to music, listening to a podcast)
- I do not pay complete attention to my surroundings when I am walking

Demographic Questionnaire
- What is your age?

- What is your gender? [] Male [] Female [] Other

- How often did you walk in a day [] Never [] Rarely (0–2 times a day) [] Often (2–4 times a day) [] Frequently (4+ times a day)

- What range best describes your daily walking time? [] 0–15 min [] 15–30 min [] 30–45 min [] 45–60 min [] 60 min and above

- In which US state do you live? _____

- How would you describe the area where you live?? [] Urban: Places with an overall population density of at least 500 people per square mile [] Rural: Places with less than 500 people per square mile

Pedestrian behavior questionnaire (short version)
''As a pedestrian, how often do you have the following behaviors?" Answers should be given on a 6-point scale:
1=very infrequently or never,
2=infrequently,
3=quite infrequently,
4=quite frequently,
5=frequently,
6=very often or always.

Errors

- I cross even if vehicles are coming because I think they will stop for me
- I walk on cycling paths when I could walk on the sidewalk.
- I run across the street without looking because I am in a hurry.

Pedestrian Social Distancing Survey

(distributed through the web-based Qualtrics Survey Platform)

Understanding pedestrian decision-making during the Covid-19 pandemic

Principle Investigator
> **Carolyn MacGregor, PhD**
> Associate Professor
> Department of Systems Design Engineering, University of Waterloo
> cgmacgre@uwaterloo.ca
> 519-888-4567 x32897

Student Investigator
> **Georgette Greenslade, MASc Candidate**
> Department of Systems Design Engineering, University of Waterloo
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<u>Purpose of the Study:</u>

You are invited to participate in this survey as part of our research study titled, '*Understanding pedestrian decision-making during the Covid-19 pandemic'* at the University of Waterloo. The COVID-19 pandemic raises interesting challenges for pedestrians. On the one hand, Canadian citizens are advised to remain at home and away from others as much as possible; and yet we are also encouraged by health officials to go for a walk for wellness while maintaining social distancing requirements (e.g., stay 6 feet apart). This study will explore how pedestrians are starting to build new "rules" for how to keep social distancing gaps between themselves and other pedestrians while walking in public spaces (e.g., sidewalks, pedestrian paths, parks). Understanding how pedestrians are currently making decisions about social distancing while walking is a major step in identifying effective ways to educate and design our walking environments for health and safety.

<u>Procedure:</u>

Should you choose to participate, you will be asked to agree to the terms and give your consent before beginning the survey. During the survey, you will be asked questions relating to your experiences as a pedestrian both prior to and during social distancing. These questions range from what you do or might do in general situations to how you might react in specific scenarios. Social distancing is new for all of us. There are no right or wrong answers. We are interested in your walking activities and thoughts about being a pedestrian. The survey, consisting of a combination of yes/no and multiple-choice questions, should take about 10-15 minutes to complete.

<u>Participation criteria:</u>

Adults (18 years and older) currently residing in the Region of Waterloo, which includes Waterloo, Kitchener, Cambridge, and the affiliated townships. We are restricting to the Waterloo Region so that we

have a reasonable understanding of the general walking environments of our respondents.

Your rights as a participant:
Your participation is voluntary; You are free to skip any questions that you do not wish to answer and/or those that make you uncomfortable. You are free to withdraw your participation at any time without any penalty by exiting the survey and/or closing your internet browser window.

Confidentiality:
You will be completing the study by an online survey operated by Qualtrics Online Surveys. When information is transmitted over the internet privacy cannot be guaranteed. There is always a risk your responses may be intercepted by a third party (e.g., government agencies, hackers). Qualtrics Online Surveys temporarily collects your ID and computer IP address to avoid duplicate responses in the dataset but will not collect information that could identify you personally. The data captured will be stored on a secure password-protected server accessible only by the researchers.

No identifiable information will be collected during this study so that individual participant's anonymity will be protected. Your name will not appear in any report, presentation or publication resulting from this research. The file linking name and participant code will be kept for a minimum of 3 years, and only the researchers associated with this project will have access to it. Your data may be included in a dataset that is open to academic researchers. Data will be de-identified (i.e., data such as names and identifying demographic information will be removed) prior to submission to the database and will be presented in aggregate form in online publications. This is integral to the research process as it allows other researchers to verify results and avoid duplicating research.

Remuneration:
In appreciation of the time, you have given to this study, you can enter your name into a draw for 1 of 4 prizes. The prizes include four gift cards, worth $25 each, for local businesses in the Region of Waterloo. Your odds of winning one of the prizes is based on the number of individuals who participate in the study. Information collected to draw for the prizes will not be linked to the study data in any way, and this identifying information will be stored separately, then destroyed after the prizes have been provided. The amount received is taxable. It is your responsibility to report this amount for income tax purposes.

Benefits of the study:
Participation in the study may not provide any personal benefit to you but the study will benefit the community. Given the current Covid-19 pandemic we are experiencing, it is important to understand pedestrians thought and decision-making processes in order to make recommendations to better design environments and educational guidance for social distancing in public spaces.

Acknowledgment:

Contact Information:

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee ORE #42014. Contact the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

For all other questions, or any questions regarding participation in this study, please feel free to email the researchers. In case of additional questions at a later time, please contact Georgette Greenslade (MASc student) or Carolyn MacGregor (Supervisor).

Thank you for considering participation in this study.

Please select the button below to get started. On the next page you will be invited to give your consent

SCREENING QUESTION

Do you currently live in the Waterloo Region of Ontario? (e.g., Kitchener, Waterloo, Cambridge, North Dumpfries, Wellesley, Wilmot, or Woolwich)

[] Yes

[] No

Consent

By giving your consent, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

I have read the information presented on the previous page about a study being conducted by Georgette Greenslade, under the supervision of Professor Carolyn MacGregor, Department of Systems Design Engineering, University of Waterloo.

I am aware that I may withdraw my consent for any of the above statements or withdraw
my participation during the survey without penalty by exiting the survey and/or closing your internet browser window.

I am aware that my data will be posted on specific databases OR made available to other researchers upon publication, so that data may be used for research purposes by other researchers.
Please be aware that all of your information will be de-identified and anonymous.

This study has been reviewed and received ethics clearance through University of
Waterloo Research Ethics Committee (ORE #42014). If you have questions for the
Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

◯ I have read and understood the information given and I agree to participate in this survey.

Data use in future research
Additionally, I consent for data collected in this study to be used in future research (e.g., the use of the results of this study in comparison with similar studies in other municipalities, provinces, or countries) that is through the database. My consent / non-consent to the future use of data does not impact my participation in this study.
◯ I consent for my data to be used in future studies.
◯ I DO **NOT** consent for my data to be used in future studies.

Demographics

a. What is your age?

[] 18 – 24

[] 25 – 34

[] 35 – 44

[] 45 – 54

[] 55 – 64

[] 65 - 74

[] 75 or older

[] Prefer not to declare

b. **What is your gender?**

[] Male[] Female   [] Other [] Prefer not to declare

c. How would you describe the areas where you do most of your walking? Select all that apply.

[] In the downtown areas (e.g., city of Waterloo, Kitchener, Cambridge)

[] In smaller towns (e.g., Wellesley, St. Jacobs)

[] In suburban areas (e.g., residential neighbourhoods)

[] In rural areas (e.g., primarily farmland)

[] In parks or recreational trails (e.g., Waterloo Park, Iron Horse Trail)

The following questions will help us generally understand your responses to different walking scenarios where other pedestrians may be present. There is no preferred answer.

a. **Before the COVID-19 pandemic (i.e., before March 2020), how would you rate your usual level of comfort when approaching other pedestrians in the following ways:**

I recognized the other pedestrians that I was approaching (e.g., neighbours, acquaintances).
[] Very Uncomfortable to Very Comfortable

I did not recognize the other pedestrians that I was approaching (i.e., strangers, or someone with back to you).
[] Very Uncomfortable to Very Comfortable

b. **During the COVID-19 pandemic (i.e., after March 2020), how would you rate your usual level of comfort when approaching other pedestrians in the following ways:**

I recognized the other pedestrians that I was approaching (e.g., neighbours, acquaintances).
[] Very Uncomfortable to Very Comfortable

I did not recognize the other pedestrians that I was approaching (i.e., strangers, or someone with back to you).
[] Very Uncomfortable to Very Comfortable

We appreciate that wearing a face mask in public is unfamiliar for most Canadians. The following questions will help us generally understand your responses to different walking scenarios where other pedestrians may be present. There is no preferred answer.

Before the COVID-19 pandemic (i.e., before March 2020), when walking in public spaces:

[] I never wore a face mask in public (preference or health reasons).

[] I would sometimes wear a face mask in a public space if I might be close to others (e.g., if I were feeling ill).

[] I always wore a face mask in a public space if I might be close to others.

After the COVID-19 pandemic (i.e., before March 2020), when walking in public spaces:

[] I never wear a face mask in public (preference or health reasons).

[] I will sometimes wear a face mask in a public space if I might be close to others (e.g., if I was feeling ill).

[] I always wear a face mask in a public space if I might be close to others.

FINAL QUESTION (Open-ended): Is there anything else you would like to tell us that might help us interpret your responses?

_____

_____

_____

_____

General Walking Habits

For the following questions about your walking habits, the word 'walk' is defined as going outside of your home or dwelling with the purpose of leaving your property.

d. **How often did you walk in a day prior to social distancing requirements (e.g., stay 6 feet away from others)?**

[] Never

[] Rarely (0–2 times a day)

[] Often (2–4 times a day)

[] Frequently (4+ times a day)

e. **How often do you walk in a day currently with social distancing?**
[] Never
[] Rarely (0–2 times a day)
[] Often (2–4 times a day)
[] Frequently (4+ times a day)

f. **Compared to my walking before social distancing, I would say that my walking frequency has …**
[] remained the same
[] Increased
[] decreased

g. **What range best described your daily walking time prior to social distancing (e.g., total time spent walking in a day)?**
[] 0–15 min [] 15–30 min [] 30–45 min [] 45–60 min [] 60 min and above

h. **What range best describes your daily walking time currently with social distancing (e.g., total time spent walking in a day)??**
[] 0–15 min [] 15–30 min [] 30–45 min [] 45–60 min [] 60 min and above

Which of the following best describes your primary reason for walking before social distancing? (Check all that apply)
[] I walked for the pleasure or general exercise.
[] I walked to work/school.
[] I walked to public transportation (buses, light rail.)
[] I walk as part of my job (e.g., postal carrier, security patrol).

Which of the following best describes your primary reason for walking with social distancing? (Check all that apply)

[] I walk for the pleasure or general exercise.

[] I walk to work/school.

[] I walk to public transportation (buses, light rail.)

[] I walk as part of my job (e.g., postal carrier, security patrol).

Walk Planning

Answer the following questions based on your experience during the current COVID-19 pandemic.

1. How often do you walk on a weekly basis?

    [] Every day

    [] A few times a week

    [] Once a week or less

2. What time of day do you typically walk? (Check all that apply)

    [] Morning (5am – 12pm)

    [] Afternoon (12pm – 7pm)

    [] Night (7pm – 5am)

3. How far do you travel during your walks?

    [] Short distance (2km or less)

    [] Moderate distance (3km – 5km)

    [] Long (6km-9km)

    [] Very Long distance (10km or greater)

4. Do you usually walk-in familiar areas or neighborhoods?

   [] Yes

   [] No

Navigation

Answer the following questions based on your experience during the current COVID-19 pandemic.

1. I intentionally walk to avoid other pedestrians or cyclists.

[] yes [] no

2. I am more aware of my proximity to other persons when it is a group of persons compared to one other person

[] Yes [] no

3. When I encounter other pedestrians wearing masks, I am not worried about maintaining social distance (i.e., 6 feet) from other pedestrians or cyclists

[] yes [] no

4. When I am wearing a mask, I am not worried about maintaining social distance (i.e., 6 feet) from other pedestrians or cyclists

[] yes [] no

5. I find it difficult to know if I am maintaining adequate physical distance (6 ft/2m) between other pedestrians or cyclists without any visual aids

[] yes [] no

6. I am comfortable with my ability to follow social distancing when I am in a crowded, public area (e.g., a park, mall)

[] yes [] no

For the following group of questions about your behaviour as a pedestrian walking alone, both before and after social distancing implementation, respond as best as you can. Answer as closely as possible to what you would choose to do using the scale provided:

1=very infrequently or never (0-1 of 10 times walking)

2=infrequently (2-3 of 10 times walking)

3=somewhat infrequently (4-5 of 10 times walking)

4=somewhat frequently (5-6 of 10 times walking)

5=frequently (7-8 of 10 times walking)

6=very often or always (9-10 of 10 times walking)

PRE-SOCIAL DISTANCING (PRIOR TO MARCH 2020)

  a. I walk on the right-hand side of the sidewalk or path so as to not bother the pedestrians I meet approaching from the other direction.

  b. I walk in cycling lanes when I could walk on the sidewalk, in order to avoid being too close to other pedestrians

  c. I start to cross on a pedestrian-crossing, and I finish crossing diagonally to avoid other pedestrians or cyclists

  d. I walk on the roadway to overtake someone who is walking slower than I am

  e. I cross outside the pedestrian crossing even if there is one (e.g., a crosswalk or zebra crossing) less than 50m away to create distance between other pedestrians or cyclists

  f. I take passageways normally forbidden to pedestrians (e.g., private property) to avoid meeting other pedestrians or cyclists on my walk

  g. I regularly make eye contact with other pedestrians as a form of communication

  h. While walking, I engage in other activities (e.g., talking, listening to music, listening to a podcast)

  i. I do not pay complete attention to my surroundings when I am walking

WITH SOCIAL DISTANCING (AFTER MARCH 2020)

   a. I walk on the right-hand side of the sidewalk or path so as to not bother the pedestrians I meet approaching from the other direction.

   b. I walk in cycling lanes when I could walk on the sidewalk, in order to avoid being too close to other pedestrians

   c. I start to cross on a pedestrian-crossing, and I finish crossing diagonally to avoid other pedestrians or cyclists

   d. I walk on the roadway to overtake someone who is walking slower than I am

   e. I cross outside the pedestrian crossing even if there is one (e.g., a crosswalk or zebra crossing) less than 50m away to create distance between other pedestrians or cyclists

   f. I take passageways normally forbidden to pedestrians (e.g., private property) to avoid meeting other pedestrians or cyclists on my walk

   g. I regularly make eye contact with other pedestrians as a form of communication

   h. While walking, I engage in other activities (e.g., talking on cell phone, listening to music or a podcast)

   i. I do not pay complete attention to my surroundings when I am walking

Screener question

Have you walked with at least one other person, either before or during the recent COVID-19 pandemic?

[] Yes [] No

(Optional based on answer to previous question)

For the following group of questions about your behaviour as a pedestrian walking with someone else, both before and after social distancing implementation, respond as best as you can. Answer as closely as possible to what you would choose to do using the scale provided:

1=very infrequently or never (0-1 of 10 times walking)

2=infrequently (2-3 of 10 times walking)

3=somewhat infrequently (4-5 of 10 times walking)

4=somewhat frequently (5-6 of 10 times walking)

5=frequently (7-8 of 10 times walking)

6=very often or always (9-10 of 10 times walking)

PRE-SOCIAL DISTANCING (PRIOR TO MARCH 2020)

1. When I am walking with other pedestrians (e.g., family members), we walk in single file on narrow sidewalks or paths so as not to get too close to other pedestrians

2. When walking with one or more other persons, I feel less worried about maintaining social or physical distancing

3. We walk on the roadway to be next to friends on the sidewalk

4. We walk on cycling paths or cycling lanes when we could walk on the sidewalk, in order to avoid being too close to other pedestrians not in my group

5. We start to cross on a pedestrian-crossing, and we finish crossing diagonally to avoid other pedestrians or cyclists

6. *We walk on the roadway to overtake someone who is walking slower than we are*

7. *We walk in the roadway to avoid crowding the sidewalk for other pedestrians*

8. We cross outside the pedestrian-crossing even if there is one (e.g., a crosswalk or zebra crossing) less than 50m away to create distance between other pedestrians or cyclists

9. We take passageways normally forbidden to pedestrians (e.g., private property) to avoid meeting other pedestrians or cyclists on my walk

10. *We regularly make eye contact with other pedestrians as a form of communication*

11. While walking, we engage in other activities (e.g., talking, listening to music or a podcast)

12. We do not pay complete attention to our surroundings when we are walking

WITH SOCIAL DISTANCING (AFTER MARCH 2020)

1. When I am walking with other pedestrians (e.g., family members), we walk in single file on narrow sidewalks or paths so as not to get too close to other pedestrians

2. When walking with one or more other persons, I feel less worried about maintaining social or physical distancing

3. We walk on the roadway to be next to friends on the sidewalk

4. We walk on cycling paths when we could walk on the sidewalk, in order to avoid being too close to other pedestrians not in my group

5. We start to cross on a pedestrian-crossing, and we finish crossing diagonally to avoid other pedestrians or cyclists

6. We walk on the roadway to overtake someone who is walking slower than we are

7. We walk in the roadway to avoid crowding the sidewalk for other pedestrians

8. We cross outside the pedestrian crossing even if there is one (e.g., a crosswalk or zebra crossing) less than 50m away to create distance between other pedestrians or cyclists

9. We take passageways normally forbidden to pedestrians (e.g., private property) to avoid meeting other pedestrians or cyclists on my walk

10. We regularly make eye contact with other pedestrians as a form of communication

11. While walking, we engage in other activities (e.g., talking, listening to music, listening to a podcast)

12. We do not pay complete attention to our surroundings when we are walking


5. **For the following questions, imagine yourself in the following scenarios (the red arrow indicates you in the scenario and the green arrows indicate the directions persons in the scenarios are travelling). Assume no masks are being worn unless specified. Answers are based as closely as possible to what you would choose to do. What would be your response in the following scenarios**?

1. Continue on current Path/No Change
2. Stop moving to let the other pedestrian(s) pass.
3. Step off the current path/sidewalk.
4. Cross to the other side of the road
5. Other_____

a. You are wearing a mask and walking on a park path (e.g., Waterloo Park), another pedestrian approaches on the same path.

You are casually walking on a sidewalk and a group of persons are walking behind you and eventually catch up to you
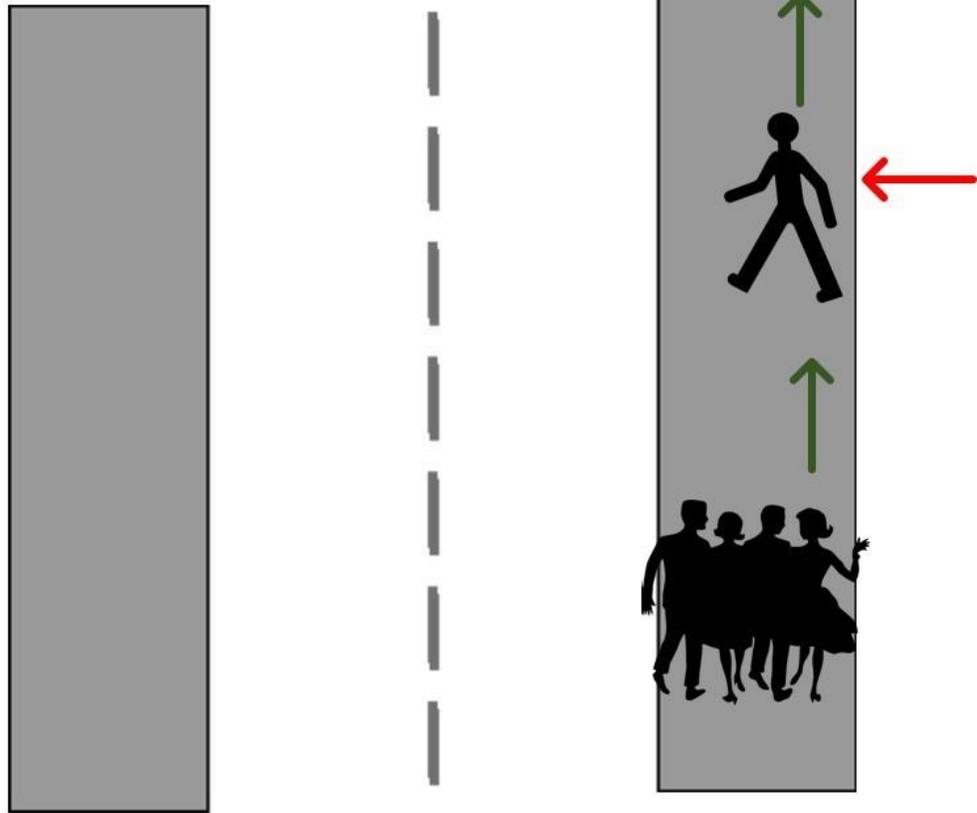
c. You are walking on the sidewalk and there is another pedestrian up ahead and you eventually catch up to them
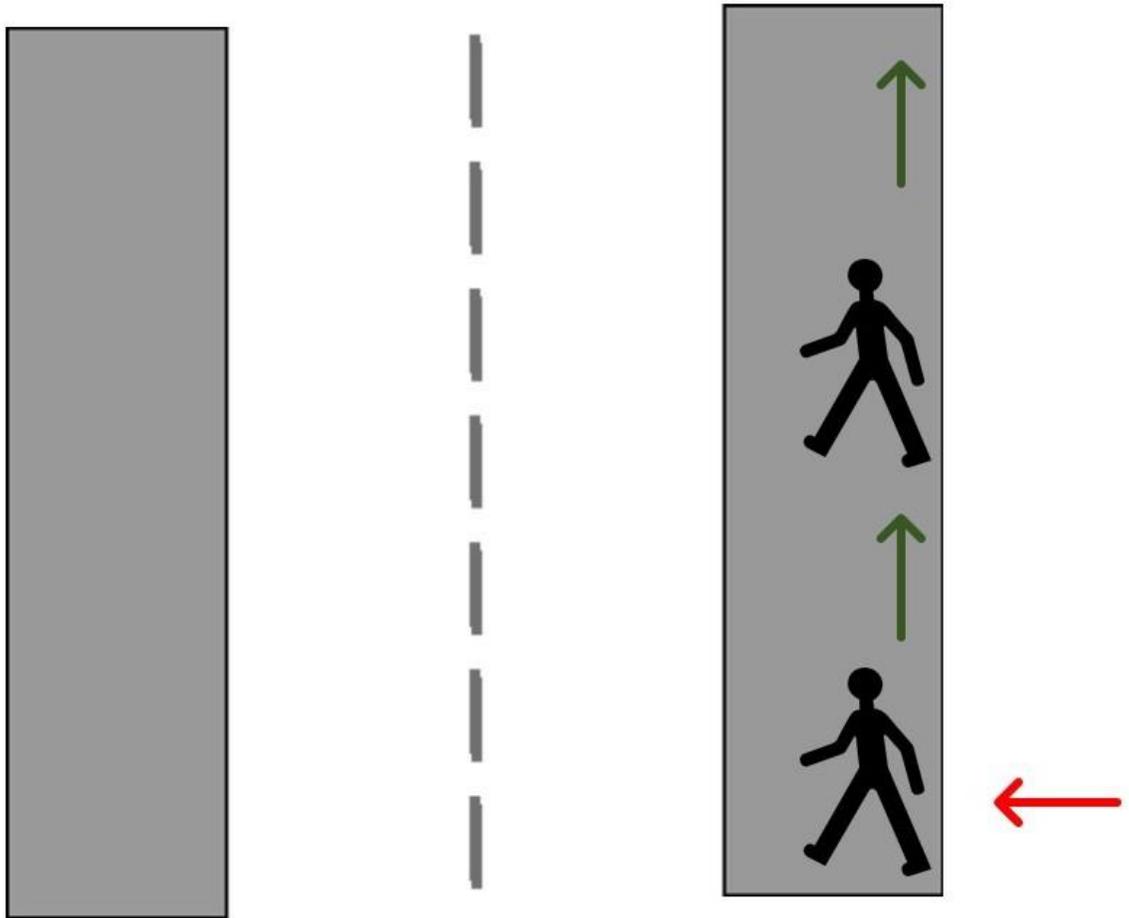
d. You are walking with a baby stroller and a group of masked pedestrians is approaching you
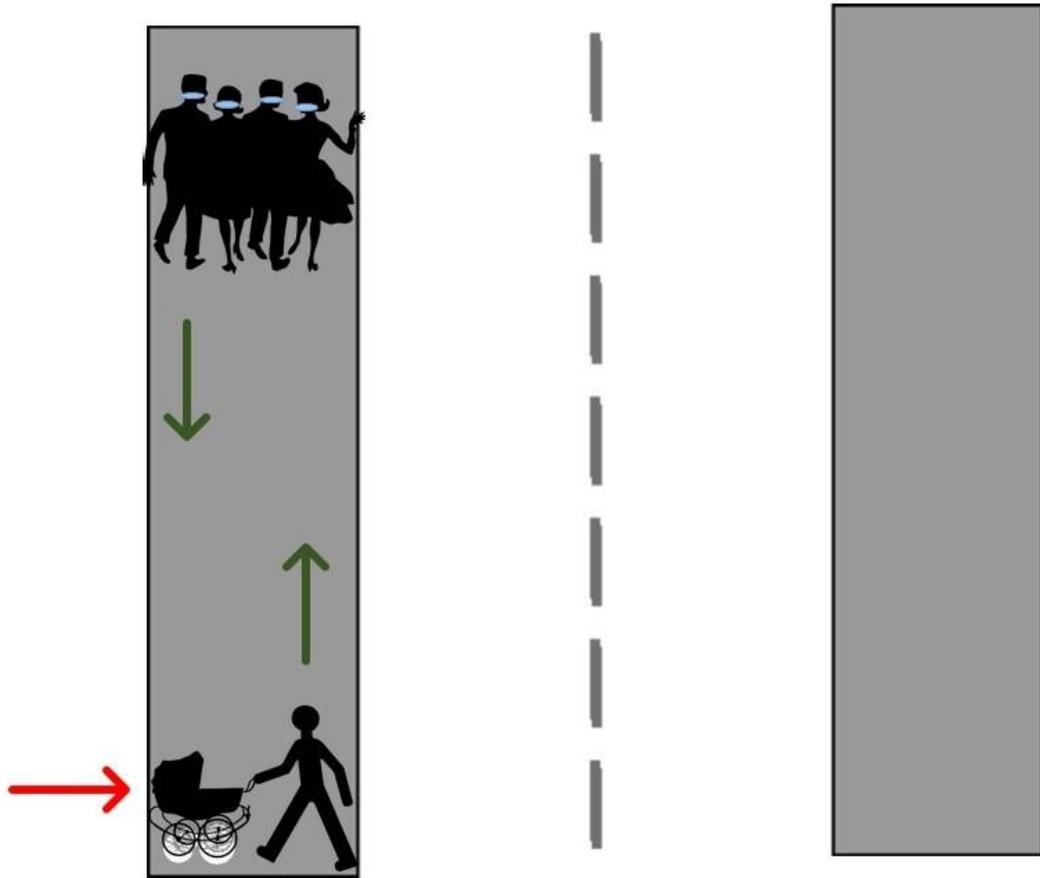
e. You are wearing a mask walking on the sidewalk of a busy main road as another pedestrian, also wearing a mask, approaches from the opposite direction on the same sidewalk.

f. You are approaching an intersection and another pedestrian is also approaching the intersection from another direction
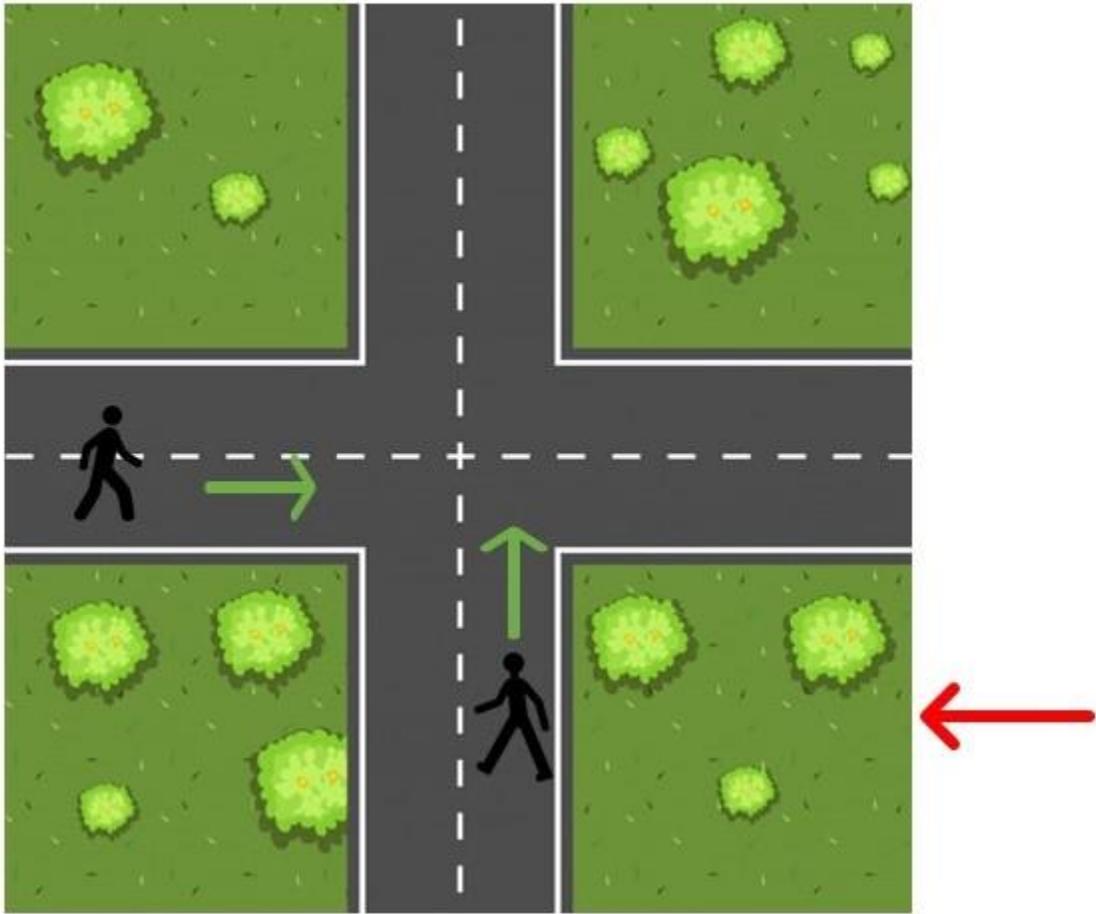
You are walking on the sidewalk of a non-busy neighborhood and a pedestrian is walking towards you and there is also another pedestrian on the opposite side of the road doing the same
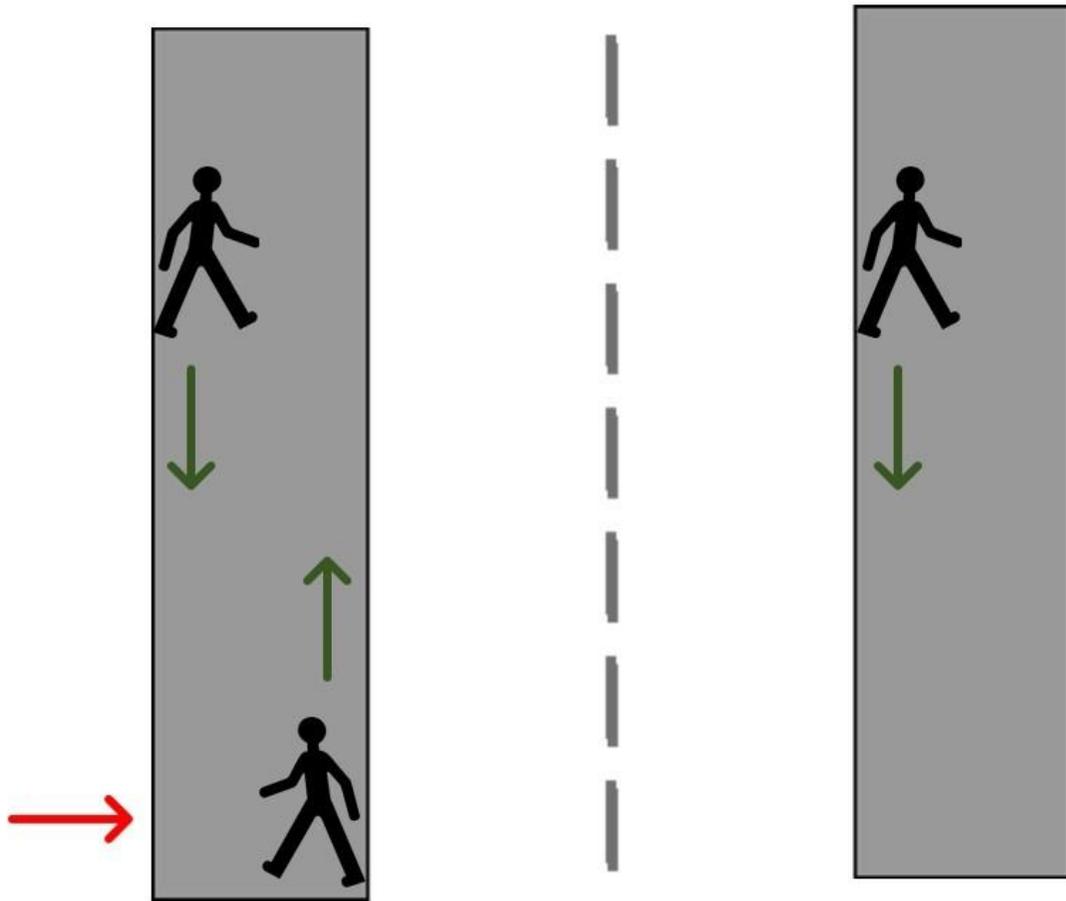
You are walking on the sidewalk of a busy main road as a group of pedestrians approach from the opposite direction on the same sidewalk
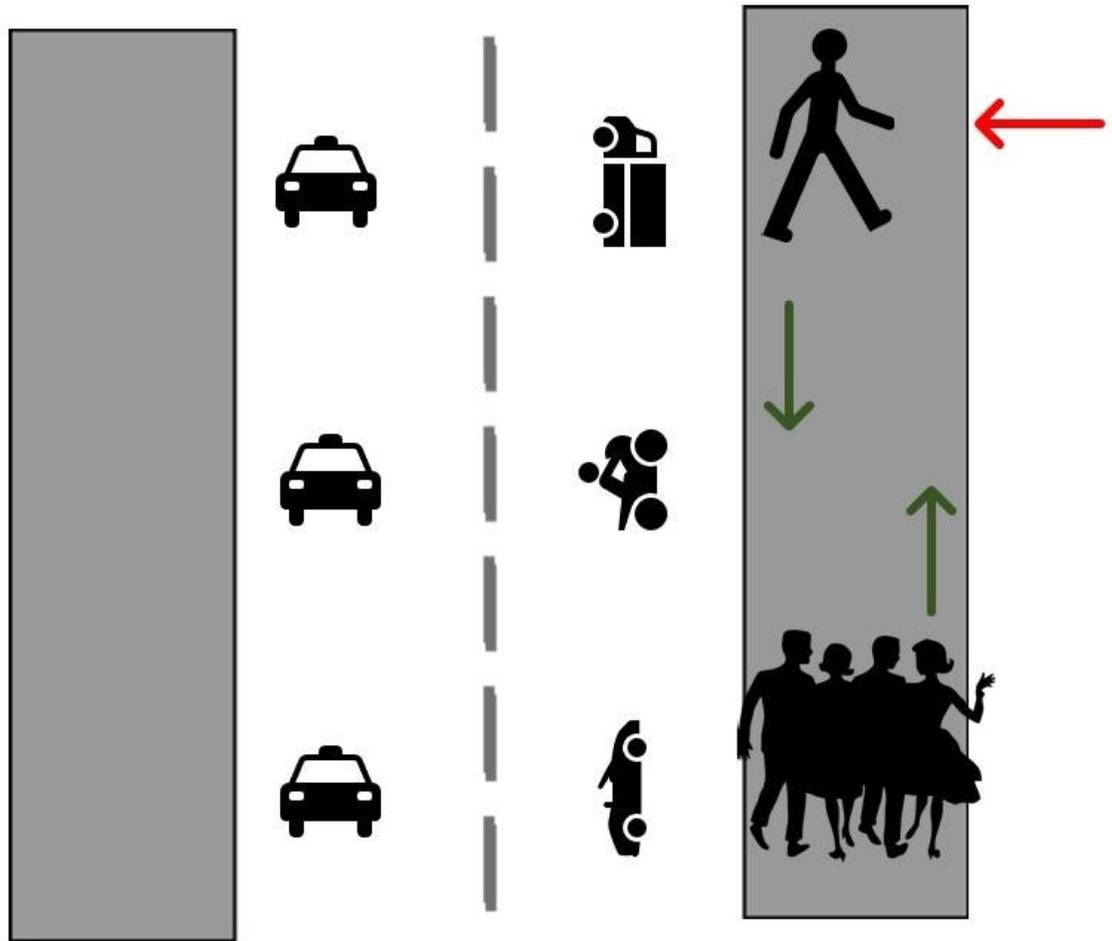
g. You are walking in a neighborhood and in the direction, you are going there is a person doing yard work. There is also another person walking in the opposing direction on the other side of the street.
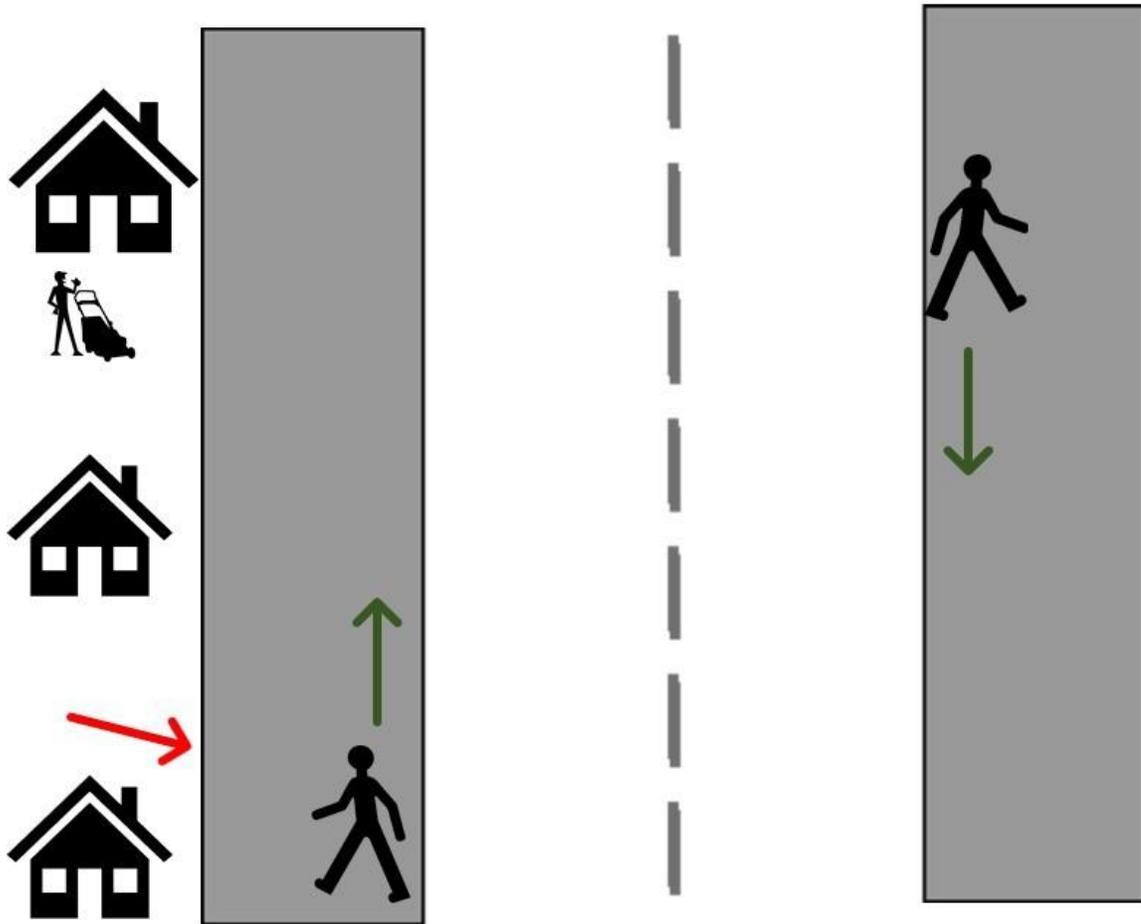
h. You are walking in a residential neighbourhood. You are walking on the sidewalk and a pedestrian is approaching you on the same sidewalk. On the opposite side of the street there is another pedestrian who you would have to pass if you crossed the road. In addition, there are three mothers walking in the road, each with a baby stroller, walking side by side, across both lanes.

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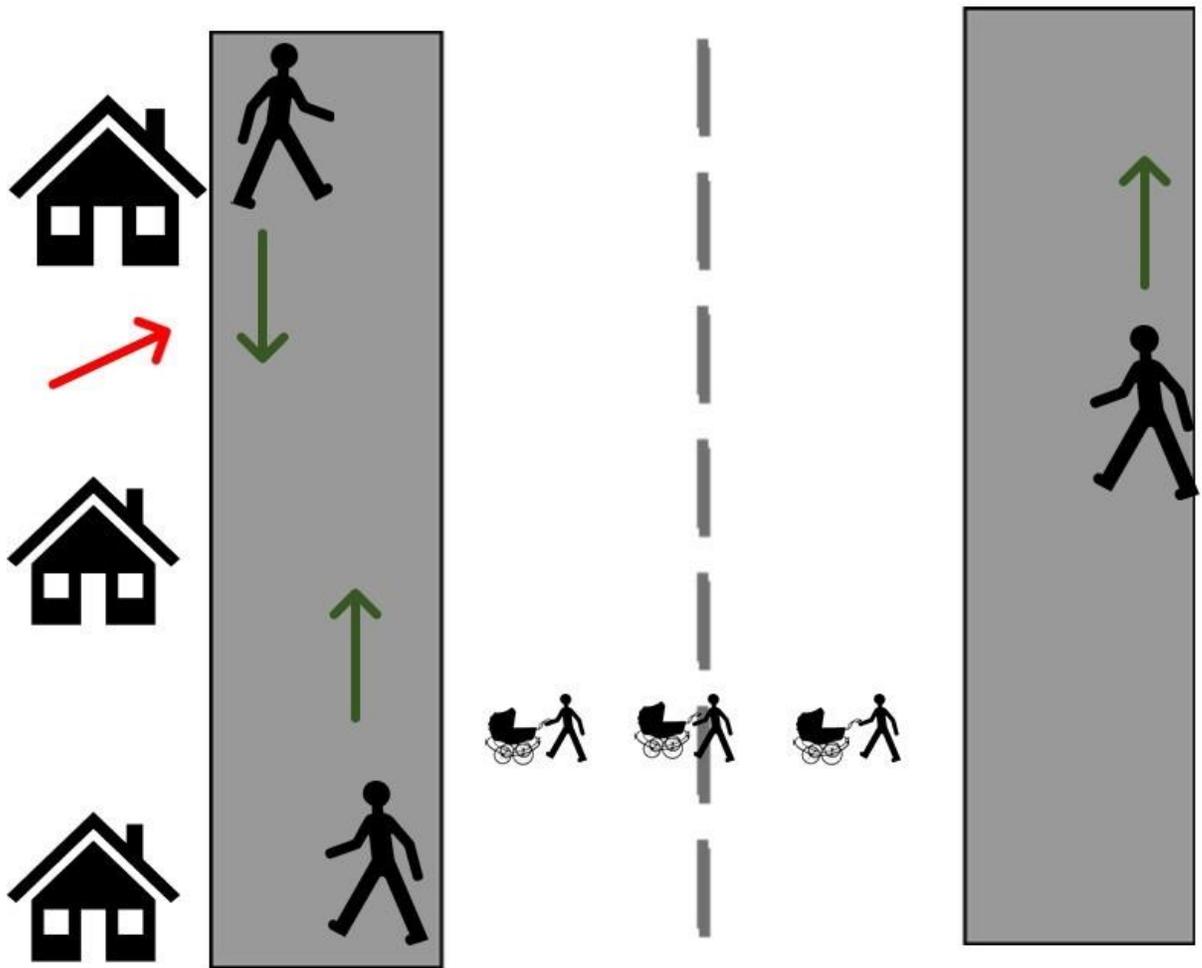
In the following section, give your opinion on visual countermeasures in place to assist with social distancing.

Countermeasures

13. Do you feel that lane markers (markers on ground) help you determine if you are correctly adhering to social distance measures?

[] yes [] no

Arrange the following visual aids, by dragging up/down, in the order that you believe they would be most effective

○

| https://www.nwahomepage.com/news/city-adds-social-distancing-markers-to-fayetteville-trails/ | |
| https://qz.com/1836247/social-distancing-markers-from-around-the-world/ | |

Now that you have completed the survey, we would like to know if your comfort level has changed regarding approaching other pedestrians during the COVID-19 pandemic

[] No change

[] More Comfortable

[] Less Comfortable

FINAL QUESTION (Open-ended): Is there anything else you would like to tell us that might help us interpret your responses?

_____

_____

_____

_____

Thank You!

Thank you for your participation in our survey "*Understanding pedestrian decision-making during the Covid-19 pandemic*". Your responses are extremely valuable in helping us understand how pedestrians are starting to build new "rules" for social distancing while walking in public spaces (e.g., sidewalks, pedestrian paths, parks). Understanding how pedestrians are currently making decisions about social distancing while walking is an important step for identifying effective ways to educate and design our walking environments for health and safety.

As a token of appreciation for taking this survey, you have an opportunity to enter a draw for one of four gift cards for local businesses in the Region of Waterloo, (valued at approximately $25 each).
[ ] Yes, I would like to be entered into the draw
[ ] No, I do not want to be entered into the draw

FUTURE STUDY SCREENING QUESTION

To gain deeper insights into pedestrians behaviours, we may do a follow-up study that will involve remote interviews to better understand how people make their social distancing decisions for different pedestrian scenarios. If you would like to be contacted about future pedestrian studies, please let us know by clicking on the following link.
Your contact information will be kept completely separate from the data collected in the survey and will not be linked to it.
[] Yes, I would like to be contacted for a follow up interview
[] No, I do not want to be contacted for a follow up interview

SIGN OFF SCREEN
Covid-19 Resources
In the event that answering one or more of the questions in this survey has caused feelings of fear, worry or anxiety or you would like more information on Covid-19, please consider visiting the following resources:
1. **Canadian Mental Health Association**
https://cmha.ca/
2. **Government of Canada**
https://www.canada.ca/en/public-health/services/diseases/coronavirus-disease-covid-19.html
3.**World Health Organization**
https://www.who.int/emergencies/diseases/novel-coronavirus-2019
Once all the data are collected and analyzed for this project, I plan on sharing this information with the research community through seminars, conferences, presentations, and journal articles.
For all other questions or if you have general comments or questions related to this study or would like to receive the research findings, please contact **Georgette Greenslade, Systems Design Engineering,**

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University of Waterloo, gegreens@uwaterloo.ca or **Carolyn MacGregor, Systems Design Engineering, University of Waterloo, cgmacgre@uwaterloo.ca**.

Georgette Greenslade- gegreens@uwaterloo.ca
Use-IT Lab
Department of Systems Design Engineering
University of Waterloo

Appendix D

Codes

Why has the frequency of your walking remained the same, increased or decreased?	fear of others	moved to place with fenced yard	doesn't want to change routine	minimize exposure
tend to drive mostly	no reason to go out	university closed	less reason to 'get out of office'	avoiding public transit
exercise	feels unsafe	no longer visiting friends	good weather	fitness
nothing else to do	no longer commute	weather	easier to walk longer	new job
loss of job	less places to go	takes longer walks in safe spaces	businesses closed	still commute to work
fear	mostly stay home	graduated	less social visits	dog walking
movement	fresh air	break from studies normally (prior to COVID-19)	staying at home more	break from work

walk for errands	don't want to bring toddler on walk	persons don't make effort to distance	not safe outdoors	no change in habits
weather	not restricted to office	get away from desk	easy access to walkable areas	same habits, but more careful
takes longer walks in safe spaces	don't go anywhere	feels safer at home	personal space needed	minimize contact with others
graduated	walk for leisure now	neighbors not mask wearing	no longer walk around work	easy finding safe walking places
break from studies normally (prior to COVID-19)	take child outside for activities	less plans to go places	no longer walk for shopping	nervous about being around others
moved to place with fenced yard	exercising indoors	easy to distance while walking	practicing self-isolation	entertain toddler
less social visits	essential shopping	exercise indoors when hot	no longer going to work	more time home
staying at home more	avoid risk	weather	more time	more effort needed to go out
necessities only	more free time	normal activities cancelled	driving less	no need to go out

need to go out	more time indoors for work	does not walk alone	something to do	university online now
walked for transit before	discomfort being around others	increased boredom	nowhere to go	less to do
no need to go anywhere	busy with work	change of scenery	Covid-19	to clear head
paranoid	practicing self-isolation	fear of exposure	avoid others	need to use transit or bike
nice weather out	increased parenting duties	get outside	activities	finding less busy places
important to get out	restlessness	has always walked daily	work outside of home	following guidelines
avoid elevator	reduce exposure	follow quarantine measures	take kid for walk	busy with work
cautious	no longer walk in parking lot near work	staying inside more	anxiety	more time to walk now
mental stimulation	work from home	risk	goes on runs	get out of house

distrust of others	fewer activities available	no longer visit shopping areas	many places closed	less walking for errands
no longer walk for shopping	access to nearby activities	still needs to live life	adhering to guidelines	good weather
risk mitigation	reduce risk of COVID-19	no longer needs to go to office	less reason to go out	activity with kids
likes being indoors	not walking anymore became habit	only go out if necessary	nothing else to do	less reasons to walk
nowhere to go	because of lockdown measures	weird to walk in previous areas	maintain physical and mental health	reduced socializing
no longer walk to transit	only leave when necessary	outdoor areas more crowded	walking usually increases in summer	less places open
walk for health maintenance	avoiding unnecessary trips	works full time	reduce contact with others	work online now
still go outside to job	hates summer	less reasons to go out	persons don't respect distancing	order groceries online

ordering groceries	nowhere to go	less reason to go out	work online	mitigating risk
not going to work	no one to see	taking precautions to avoid risk	less socialising	did not want to disrupt routine
less motivation	errands only	types of walks have changed	nowhere to go specific	risk of exposure
avoid exposure	children at home now	intentionally walks now	leisurely walks	still goes to work
no social enjoyment when out	does not walk with children	more time at gym before COVID-19	not enough reason to be outside	to see other people
health maintenance	distancing and mask wearing measures means no change	more time commuting before COVID-19	less to do	no longer walking for groceries
family obligations				

Appendix E

Summary of Social Distancing Scenario Responses

Summary of Social Distancing Scenario Response Results

Scenario	Continue current path/no change	Stop moving to let the other pedestrian(s) pass	Step off the current path/sidewalk	Cross to the other side of the road	Other
1. You are wearing a mask and walking on a park path (e.g., Waterloo Park); another pedestrian approaches on the same path	21.9%	2.9%	66.2%	5.2%	3.8%
2. You are casually walking on a sidewalk, and a group of persons are walking behind you and eventually catch up to you.	11.4%	13.8%	41.4%	26.7%	6.7%
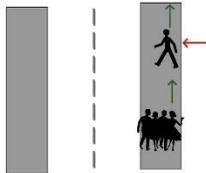
Summary of Social Distancing Scenario Response Results

Scenario	Continue current path/no change	Stop moving to let the other pedestrian(s) pass	Step off the current path/sidewalk	Cross to the other side of the road	Other
3. You are walking on the sidewalk, and there is another pedestrian up ahead, and you eventually catch up to them	9%	4.3%	51.9%	26.2%	8.6%
4. You are walking with a baby stroller, and a group of masked pedestrians is approaching you.	12.4%	27.3%	26.3%	25.4%	8.6%

Summary of Social Distancing Scenario Response Results

| Scenario	Continue current path/no change	Stop moving to let the other pedestrian(s) pass	Step off the current path/sidewalk	Cross to the other side of the road	Other
5. You are wearing a mask walking on the sidewalk of a busy main road as another pedestrian, also wearing a mask, approaches from the opposite direction on the same sidewalk.	44.8%	11.9%	30.5%	6.2%	6.7%

Summary of Social Distancing Scenario Response Results

Scenario	Continue current path/no change	Stop moving to let the other pedestrian(s) pass	Step off the current path/sidewalk	Cross to the other side of the road	Other
 6. You are approaching an intersection, and another pedestrian is also approaching the intersection from another direction 	15.2%	69%	6.2%	4.8%	4.8%

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Summary of Social Distancing Scenario Response Results

| Scenario	Continue current path/no change	Stop moving to let the other pedestrian(s) pass	Step off the current path/sidewalk	Cross to the other side of the road	Other
7. You are walking on the sidewalk of a non-busy neighbourhood, and a pedestrian is walking towards you, and there is also another pedestrian on the opposite side of the road doing the same	18.1%	7.1%	70.5%	1%	3.3%
8. You are walking on the sidewalk of a busy main road as a group of pedestrians approach from the opposite direction on the same sidewalk.	12.4%	33.3%	41%	5.2%	8.1%
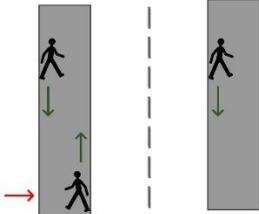
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Summary of Social Distancing Scenario Response Results

| Scenario	Continue current path/no change	Stop moving to let the other pedestrian(s) pass	Step off the current path/sidewalk	Cross to the other side of the road	Other
  9. You are walking in a neighbourhood, and in the direction you are going, there is a person doing yard work. There is also another person walking in the opposing direction on the other side of the street.	64.3%	3.3%	28.1%	1.4%	2.9%

Summary of Social Distancing Scenario Response Results

Scenario	Continue current path/no change	Stop moving to let the other pedestrian(s) pass	Step off the current path/sidewalk	Cross to the other side of the road	Other
10. You are walking in a residential neighbourhood. You are walking on the sidewalk, and a pedestrian is approaching you on the same sidewalk. On the opposite side of the street, there is another pedestrian whom you would have to pass if you crossed the road. In addition, there are three mothers walking in the road, each with a	21.9%	30.5%	31.9%	7.6%	8.1%

Summary of Social Distancing Scenario Response Results

Scenario	Continue current path/no change	Stop moving to let the other pedestrian(s) pass	Step off the current path/sidewalk	Cross to the other side of the road	Other
baby stroller, walking side by side, across both lanes.					

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WATERLOO

INFORMATION SHEET FOR PARTICIPANTS

Title of the project; Remote Interview: Understanding pedestrian decision making during the Covid-19 pandemic

Team members:

Carolyn MacGregor, PhD	Georgette Greenslade
Associate Professor	MASc Candidate
Department of	Department of
Systems Design Engineering	Systems Design Engineering
University of Waterloo	University of Waterloo
Email: **cgmacgre@uwaterloo.ca**	Email:**gegreens@uwaterloo.ca**
Phone: 519-888-4567 x32897	

Purpose of the Study:

You are invited to participate in this remote interview as part of our research study titled, '*Remote Interview: Understanding pedestrian decision making during the Covid-19 pandemic'* at the University of Waterloo. The COVID-19 pandemic raises interesting challenges for pedestrians. On the one hand, Canadian citizens are advised to remain at home and away from others as much as possible; and yet we are also encouraged by health officials to go for a walk for wellness while maintaining social distancing requirements (e.g., stay 6 feet apart). This study will explore how pedestrians are starting to build new "rules" for how to keep social distancing gaps between themselves and other pedestrians while walking in public spaces (e.g., sidewalks, pedestrian paths, parks). Understanding how pedestrians are currently making decisions about social distancing while walking is an important step for identifying effective ways to educate and design our walking environments for health and safety.

Procedure:

Remote Interview Screening Survey

Should you choose to participate, you will be asked to complete a short survey that will ask you questions about your current walking habits. The survey, consisting of multiple-choice questions, should take about 3-5 minutes to complete. These questions, which were previously asked in the anonymous survey, will be used to determine your eligibility for participation in the remote interview portion of the study, as we are looking for persons with certain characteristics.

Remote Interview

The remote interview will be both video and audio recorded and conducted via Microsoft Teams, an online platform, at an agreed date and time of your convenience. The interview, which will last no longer than 30 minutes, will consist of questions that will assist in understanding what behaviours and thought processes you use as a pedestrian currently practicing social distancing while walking within the Waterloo Region.

Participation criteria:

Adults (18 years and older) currently residing in the Region of Waterloo, which includes Waterloo, Kitchener, Cambridge, and the affiliated townships and adults that have completed the anonymous web survey *Understanding pedestrian decision making during the Covid-19 pandemic* and walk outside at least once a week. We are restricting to the Waterloo Region so that we have a reasonable understanding of the general walking environments of our respondents.

Your rights as a participant:

Remote Interview Screening Survey

Your participation is voluntary. In the survey, you are free to skip any questions that you do not wish to answer and/or those that make you uncomfortable. You are free to withdraw your participation at any time without any penalty by exiting the survey and/or closing your internet browser window.

Remote Interview

If you are selected for the remote interview, your participation is voluntary. It will involve a remote interview no more than 30 minutes in length to take place at a mutually agreed upon date and time. You

may decline to answer any of the interview questions if you so wish. Further, you may decide to withdraw from this study at any time without any negative consequences by advising the researcher. With your permission, the interview will be audio recorded to facilitate collection of information, and later transcribed for analysis.

<u>Confidentiality:</u>

You will be completing the interview screening by an online survey operated by Qualtrics Online Surveys. When information is transmitted over the internet privacy cannot be guaranteed. There is always a risk your responses may be intercepted by a third party (e.g., government agencies, hackers). Qualtrics Online Surveys temporarily collects your ID and computer IP address to avoid duplicate responses in the dataset but will not collect information that could identify you personally. University of Waterloo researchers will not collect or use internet protocol (IP) addresses or other information which could link your participation to your computer or electronic device without first informing you.

This study will use the Microsoft Teams platform to collect data, which is an externally hosted cloud-based service. A link to their privacy policy is available here. Please note that there is a small risk with any platform such as this of data that is collected on external servers falling outside the control of the research team. If you are concerned about this, we would be happy to make alternative arrangements for you to participate, perhaps via telephone. Please talk to the researcher if you have any concerns

The data captured will be stored on a secure password-protected server accessible only by the researchers. Your name will not appear in any report, presentation or publication resulting from this research, however, with your permission anonymous quotations may be used. The file linking name and participant code will be kept for a minimum of 3 years, and only the researchers associated with this project will have access to it. Your data may be included in a dataset that is open to academic researchers. Data will be de-identified (i.e., data such as names and identifying demographic information will be removed) prior to submission to the database and will be presented in aggregate form in online publications. This is integral to the research process as it allows other researchers to verify results and avoid duplicating research.

Remuneration:

In appreciation of the time, you have given to this study, you can enter your name into a draw for 1 of 4 prizes. The prizes include four gift cards, worth $25 each, for local businesses in the Region of Waterloo. Odds of winning are 1 in 3. Participating in the remote interview automatically gives you an entry into the draw. Your odds of winning one of the prizes is based on the number of individuals who participate in the study. Information collected to draw for the prizes will not be linked to the study data in any way, and this identifying information will be stored separately, then destroyed after the prizes have been provided. The amount received is taxable. It is your responsibility to report this amount for income tax purposes.

Benefits of the study:

Participation in the study may not provide any personal benefit to you but the study will benefit the community. Given the current Covid-19 pandemic we are experiencing, it is important to understand pedestrians' thought and decision-making processes in order to make recommendations to better design environments and educational guidance for social distancing in public spaces.

Acknowledgment:

This study is funded in part through a Faculty Research Fund held by the supervisor at the University of Waterloo.

Contact Information:

This study has been reviewed and received ethics clearance through the University of Waterloo Research Ethics Committee ORE #42348. If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

For all other questions, or any questions regarding participation in this study, please feel free to email the researchers. In case of additional questions at a later time, please contact Georgette Greenslade (MASc student) or Carolyn MacGregor (Supervisor).

Thank you for considering participation in this study.

Consent

By giving your consent, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

When information is transmitted over the internet privacy cannot be guaranteed. There is always a risk your responses may be intercepted by a third party (e.g., government agencies, hackers). University of Waterloo researchers will not collect or use internet protocol (IP) addresses or other information which could link your participation to your computer or electronic device without first informing you.

As a participant in this study, I agree to being videotaped and audio recorded for the purpose of recording a transcript of the interview. I am aware that I may withdraw this consent at any time during the interview or up to 7 days afterwards, by notifying the researchers, without penalty, at which point, the videotape will be erased.

I am aware that all of my information will be de-identified and anonymous for the purposes of any research analysis, publications, or presentations made by the researchers.

I am aware that my de-identified and anonymized data may be included in a larger database to allow for future research (e.g., the use of the results of this study in comparison with similar studies in other municipalities, provinces, or countries) that is through the database).

I have read the information presented on the information page about a study being conducted by Georgette Greenslade, under the supervision of Professor Carolyn MacGregor, Department of Systems Design Engineering, University of Waterloo. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted. I am aware that I may withdraw from the study without penalty at any time by advising the researchers of this decision.

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

◯ YES ◯ NO

I agree to have my interview video and audio recorded.

◯ YES ◯ NO

I agree to the use of anonymous quotations in any thesis or publication that comes of this research.

◯ YES ◯ NO

Data use in future research

Additionally, I consent for data collected in this study to be used in future research (e.g., the use of the results of this study in comparison with similar studies in other municipalities, provinces, or countries) that is through the database). My consent / non-consent to the future use of data does not impact my participation in this study.

◯ I consent for my data to be used in future studies.

◯ I DO **NOT** consent for my data to be used in future studies.

Participant Name: _____

Participant Signature: _____

Date: _____

Interview Screening Questionnaire

Remote Interview: Understanding pedestrian decision-making during the Covid-19 pandemic

Principle Investigator
Carolyn MacGregor, PhD
Associate Professor
Department of Systems Design Engineering, University of Waterloo
cgmacgre@uwaterloo.ca
519-888-4567 x32897

Student Investigator
Georgette Greenslade, MASc Candidate
Department of Systems Design Engineering, University of Waterloo
gegreens@uwaterloo.ca

<u>Purpose of the Study:</u>
You are invited to participate in this screening survey as part of our research study titled, 'Remote Interview: Understanding pedestrian decision-making during the Covid-19 pandemic' at the University of Waterloo. The COVID-19 pandemic raises interesting challenges for pedestrians. On the one hand, Canadian citizens are advised to remain at home and away from others as much as possible; and yet we are also encouraged by health officials to go for a walk for wellness while maintaining social distancing requirements (e.g., stay 6 feet apart). This study will explore how pedestrians are starting to build new "rules" for how to keep social distancing gaps between themselves and other pedestrians while walking in public spaces (e.g., sidewalks, pedestrian paths, parks). Understanding how pedestrians are currently making decisions about social distancing while walking is an important step for identifying effective ways to educate and design our walking environments for health and safety.

<u>Procedure:</u>
Should you choose to participate; you will be asked to complete a short survey that will ask you questions about your current walking habits. The survey, consisting of multiple-choice questions, should take about 3-5 minutes to complete. These questions, which were previously asked in the anonymous survey, will be used to determine your eligibility for participation in the remote interview portion of the study, as we are looking for persons with certain characteristics.

<u>Participation criteria:</u>
Adults (18 years and older) currently residing in the Region of Waterloo, which includes Waterloo, Kitchener, Cambridge, and the affiliated townships and walk outside at least once a week. We are restricting to the Waterloo Region so that we have a reasonable understanding of the general walking environments of our respondents.

Your rights as a participant:
Your participation is voluntary; you are free to skip any questions that you do not wish to answer and/or those that make you uncomfortable. You are free to withdraw your participation at any time without any penalty by exiting the survey and/or closing your internet browser window.

Confidentiality:
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Benefits of the study:
Participation in the study will not provide direct personal benefit to you, but the study will benefit the community. Given the current Covid-19 pandemic we are experiencing, it is important to understand pedestrians' thought and decision-making processes in order to make recommendations to better design environments and educational guidance for social distancing in public spaces.

Acknowledgment:
This study is funded in part through a Faculty Research Fund held by the supervisor at the University of Waterloo.

Contact Information:
This study has been reviewed and received ethics clearance through the University of Waterloo Research Ethics Committee ORE #42348. If you have questions for the Committee, contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

For all other questions, or any questions regarding participation in this study, please feel free to email the researchers. In case of additional questions at a later time, please contact Georgette Greenslade (MASc student) or Carolyn MacGregor (Supervisor).

Thank you for considering participating in this study.

Please select the button below to get started.

i. **With current social distancing, how often do you walk outside of your home in a week?**

[] Never

[] Infrequently (1–2 times a week)

[] Often (3-4 times a week)

[] Frequently (5+ times a week)

---------------------SELECTION RESPONSE --------------------------------

IF RARELY, OFTEN OR FREQUENTLY SELECTED, SURVEY CONTINUES ON.

IF NEVER SECLECTED, SCREEN SHOWS

Thank you for your interest in participating in this study. Unfortunately, you do not qualify based on the walking frequency selected.

Remote Interview: Understanding pedestrian decision-making during the Covid-19 pandemic

Principle Investigator
Carolyn MacGregor, PhD
Associate Professor
Department of Systems Design Engineering, University of Waterloo
cgmacgre@uwaterloo.ca
519-888-4567 x32897

Student Investigator
Georgette Greenslade, MASc Candidate
Department of Systems Design Engineering, University of Waterloo
gegreens@uwaterloo.ca

Purpose of the Study:
You are invited to participate in this screening survey as part of our research study titled, 'Remote Interview: *Understanding pedestrian decision-making during the Covid-19 pandemic'* at the University of Waterloo. The COVID-19 pandemic raises interesting challenges for pedestrians. On the one hand, Canadian citizens are advised to remain at home and away from others as much as possible; and yet we are also encouraged by health officials to go for a walk for wellness while maintaining social distancing requirements (e.g., stay 6 feet apart). This study will explore how pedestrians are starting to build new "rules" for how to keep social distancing gaps between themselves and other pedestrians while walking in public spaces (e.g., sidewalks, pedestrian paths, parks). Understanding how pedestrians are currently making decisions about social distancing while walking is an important step for identifying effective ways to educate and design our walking environments for health and safety.

Procedure:
Should you choose to participate; you will be asked to complete a short survey that will ask you questions about your current walking habits. The survey, consisting of multiple-choice questions, should take about 3-5 minutes to complete. These questions, which were previously asked in the anonymous survey, will be used to determine your eligibility for participation in the remote interview portion of the study, as we are looking for persons with certain characteristics. In addition, we are looking for persons that make up a representative sample of the respondents from our phase 1 web survey (Understanding pedestrian decision-making during the Covid-19 pandemic).

Participation criteria:
Adults (18 years and older) currently residing in the Region of Waterloo, which includes Waterloo, Kitchener, Cambridge, and the affiliated townships and walk outside at least once a week. We are restricting to the Waterloo Region so that we have a reasonable understanding of the general walking environments of our respondents.

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Benefits of the study:
Participation in the study will not provide direct personal benefit to you, but the study will benefit the community. Given the current Covid-19 pandemic we are experiencing, it is important to understand pedestrians' thought and decision-making processes in order to make recommendations to better design environments and educational guidance for social distancing in public spaces.

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Thank you for considering participating in this study.

Please select the button below to get started.

    <u>SCREENING QUESTION</u>

j. With current social distancing, how often do you walk outside of your home in a week?
[] Never

[] Infrequently (1–2 times a week)

[] Often (3-4 times a week)

[] Frequently (5+ times a week)

Consent

By giving your consent, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

I have read the information presented on the previous page about a study being conducted by Georgette Greenslade, under the supervision of Professor Carolyn MacGregor, Department of Systems Design Engineering, University of Waterloo.

I am aware that I may withdraw my consent for any of the above statements or withdraw my participation during the survey without penalty by exiting the survey and/or closing your internet browser window.

I am aware that all of my information will only be shared with the research team.

This study has been reviewed and received ethics clearance through the University of Waterloo Research Ethics Committee (ORE #42348). If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

- o I have read and understood the information given and I agree to participate in this survey
  (Participants will be unable to proceed with the survey without giving consent).

k. How would you describe the areas where you do most of your walking? Select all that apply.
[] In the downtown areas (e.g., city of Waterloo, Kitchener, Cambridge)
[] In smaller towns (e.g., Wellesley, St. Jacobs)
[] In suburban areas (e.g., residential neighbourhoods)
[] In rural areas (e.g., primarily farmland)
[] In parks or recreational trails (e.g., Waterloo Park, Iron Horse Trail)

l. Which of the following best describes your primary reason for walking with social distancing? (Check all that apply)
[] I walk for the pleasure or general exercise.
[] I walk to work/school.
[] I walk to public transportation (buses, light rail.)
[] I walk as part of my job (e.g., postal carrier, security patrol).

m. What is your age?
[] 18 – 24
[] 25 – 34
[] 35 – 44
[] 45 – 54
[] 55 – 64
[] 65 - 74
[] 75 or older
[] Prefer not to declare

n. What is your gender?
[] Male[] Female   [] Other [] Prefer not to declare

o. First Name
  _____

p. Email Address
  _____

END OF SURVEY MESSAGE

Thank you for taking the time to complete this survey. We appreciate your feedback.

Appendix H

Interview Guide

INTERVIEW PROCEDURE

- After an interview time slot is selected by the participant via the use of a DOODLE POLL, an invitation to join a scheduled meeting via Microsoft Teams will be sent as confirmation

- At the scheduled interview time, the guide on the next page will be used to steer the interview process. It includes the main points that will be asked of the interview participant.

- A short profile will be filled out for each interview:

    o **Participant ID**: This will be a random assortment of characters to anonymize the identity of participants.

    o **Age:** Taken from interview screener survey

    o **Gender:** Taken from interview screener survey

    o **Walking Location(s):** Taken from interview screener survey

    o **Walking Purpose(s):** Taken from interview screener survey

PROFILE (To be filled in before or at beginning of interview)

Participant ID:

Age:

Gender:

Location:

Purpose:

Frequency:

Introduction to Interviewee

Hi, **[Name]**, Thank you for joining us today and agreeing to participate in this research study and having a chat with us today.

We will be recording this interview for our own records and no one else will have access other than the research team to help us with our analysis.

I would like to confirm that you are consenting to this interview being videotaped and recorded today.

You are free to withdraw your consent at any time and if you wish to stop this interview at any time, you are free to do so.

Explanation of interview process

How this will work, I will ask you questions about your walking experiences in the region and we will have a discussion on what you do or would do in certain situations, and why you make those choices. There are no right or wrong answers here today. We just want to understand how pedestrians behave in certain situations right now with social distancing.

Before we get started, do you have any questions or comments?

Interview

1. **Recollection of recent walk (during COVID-19/social distancing)**
    a. **Duration**
    b. **Alone/with others?**
    c. **Type of area**
        i. **Reason for this area?**
        ii. **Familiar with area?**
    d. **Reason for walking**
        i. **Why did you decide this?**

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        ii. **What thoughts and steps did you have, and do as you prepare for your walk?**

    e. **How did you decide what actions you would take during walk? Where etc.?**

    f. **Were you doing anything else while walking, e.g., talking on phone, music, podcast etc.?**

    g. **Encounter other pedestrians?**

        i. **Thoughts or feelings?**

    h. **Mask/no mask**

        i. **How does wearing a mask make you feel as you go about walking?**

        ii. **What are your thoughts on seeing others wearing a mask or not wearing a mask in public?**

        iii. **How did you decide to move during walk?**

    i. **Thoughts, feelings during walk**

        i. **Before walk?**

        ii. **End walk?**

    j. **Did you feel that the infrastructure was suitable enough for you to practice social distancing in a comfortable manner?**

    k. **Most enjoyable aspect?**

    l. **Least enjoyable aspect?**

    m. **Comparison to pre-COVID-19? E.g., Any differences you may have noticed? Habits?**

    n. **What are the steps that go into your walking process (before, during? end)**

2. **Have you noticed any visual aids or notices about social distancing on your walk(s)?**

    a. **Do you feel they make any impact for you, good or bad?**

    b. **Are they good indicators of distance? What do you use to determine distance?**

3. **How is walk frequency determined? (weather, motivation, necessary)**

4. **Hypothetical Scenario section**

<u>OPTIONS (ask one that has not been discussed)</u>

Earlier we spoke about....

    a. **Walking downtown/uptown**

Streets busy with cars, cyclists passing by and other persons around you. Walking uptown waterloo in the afternoon and a group of three persons walks towards you unmasked? How would you respond? What if wearing masks?

    i. **Alone/group (whichever has not been covered) coming towards you with/without mask. What is going through your mind here?**

    ii. **Compared to other locations (park, or neighborhood) would you approach the walk differently or feel different?**

    b. **Walking suburban areas**

        i. **Alone/group (whichever has not been covered) coming towards you with/without mask. What is going through your mind here?**

        ii. **Compared to other locations (park, or neighborhood) would you approach the walk differently or feel different?**

    c. **Walking in parks or trails**

        i. **Alone/group (whichever has not been covered) coming towards you with/without mask. What is going through your mind here?**

        ii. **Compared to other locations (park, or neighborhood) would you approach the walk differently or feel different?**

    d. **Asked about grocery shopping**

5. **What reasons would you have for ending a walk?**

6. **In a perfect world, what is one thing you think would be most beneficial to you that would make being a pedestrian with social distancing easier or a better experience?**

Open floor for any other insights interviewee would like to share

Is there anything else you would like to share with us that maybe did not come up earlier or that you think would be beneficial?

Closing interview

Thank you! Enjoy the rest of your day!

Appendix I

Affinity Diagramming

created distance between others while walking

moves as far away as possible when pedestrian approaches

stepd onto grass to create distance on trail

stood back from others

jaywalk to create distance

walk in street/road to avoid others

walks on private property to create distance

used grass/bush near path to distance from others/pass others

walks in bike lane to create distance

step onto grassy area to avoid person at bus stop

step off walking path to create distance with others

go to edge of walking trail to create distance

will step off the path for others especially if elderley (vulnerable)

[trail walk] step as far away as possible when others approaching

walk on private property/lawn to create distance on busy street

jaywalk to create distance on busy street

---

walked in the morning

walks twice daily [morning & evening]

walk in the evening

walk at night

walk in the morning

walk in the early morning

walks 4 times daily

walk 2-3 times daily

walk daily

---

watch for escape routes while walking

find rules before taking action

clean shopping cart before using

gives wide berth when grocery shopping

look at surrounding area to create distance from others on all walks

steps on driveway or pavement when distance needed

(in neighborhood) step off path for groups and older persons

judges other pedestrians to determine how they will act (i.e. move or not)

stood in isolated area to avoid crowd

will hold breath if distancing impossible

(walk in park/trail)- go off path to avid crowds

does not distance on family walk

attempts distance on walk with friend

first look at surroundings in someone walking towards her at same speed

second (if someone walking towards me)- look for a driveway or green space near sidewalk

third (in front) see if no one else is coming and step off sidewalk

Row group 1:

- wear mask in downtown area
- does not bring a mask on walk
- wear mask in crowded outdoor areas
- take mask off after walk
- put mask on indoors
- does not wear mask when going for walk
- wears mask when going to store
- does not wear mask during walk
- wears mask outdoors when crowded
- wear mask to walk from apartment unit to outside
- take off mask before starting walk
- wears masks outdoors when distancing difficult

- wore mask and gloves [during park walk]
- does not wear mask during walk
- did not wear mask on walk
- does not wear a mask during walk
- does not wear mask outdoors typically
- wash hands after touching items brought in

Row group 2:

- walk with neighbor
- walk with mom and sister
- walked alone
- walk with partner
- walked with partner
- social distance walk with acquaintance
- walks with partner

- walks with husband/partner
- walk with two dogs
- walk with dog alone
- walk with dog with partner
- walk with neighbors dogs

Row group 3:

- put on shoes
- get sanitizer and tissue for walk
- put phone in pocket before walk
- leash dogs before leaving
- start walk tracking app before walk
- wash hands before walking
- put on mask before walking
- got headphones for walk
- put on shoes before walking
- put on gloves before walking
- check time before walk
- put on shoes before walk

- got clothing for walk
- decide where to walk based on time
- organize walk with others
- put on gym clothes before walk
- meet walking partner(s) before walk
- put on clothes based on weather
- get cellphone for walk
- put in headphones and start podcast before walk
- takes hand sanitizer and wipes when walking
- washes hands before walking
- put on sunscreen before walking
- bring phone on walk

- takes a mask with her before walking
- planned to walk for 30 minutes before walk
- gauge distance between neighbor before walking

Row group 4:

- walks with dog in surrounding neighborhood (near home)
- walk where dogs go/lead
- walk a specific route
- walked in suburban area/streets
- walks near train tracks
- walk throughout neighborhood and park trail
- walk around the block
- usually walks on the boulevard(road?)
- walk specific route

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walk at leisurely pace

stop while dogs do their business

check time during walk

set out on walking route

walks to get dogs out to exercise

walked to the clinic/doctor

went for breakfast

walks to work instead of taking the bus/transit