Safe Routes to Monmouth Elementary School

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Safe Routes to Monmouth Elementary School

By
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An Honors Thesis Submitted in Partial Fulfillment of the Requirements for Graduation from the Western Oregon University Honors Program

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ABSTRACT

The present study is an assessment of the built environment--defined by C.H. Williams (2007) as physical or manmade features such as sidewalks, street lights, traffic, and parks that impact physical activity--of the Monmouth Elementary School walk zone and a discussion of its influence on physical activity levels. This study aims to address the following questions: (1) how walkable is the walk zone of Monmouth Elementary School and (2) what areas are most and least suited for walking? Sidewalks, crosswalks, and street lights were assessed using reliable portions of a validated walkability survey through Safe Routes to School (Appendix 1). In the entire walk zone of Monmouth Elementary School, 56.2 percent of sidewalk is continuous, 30.2 percent is discontinuous, and 13.6 percent is absent. Furthermore, there are 75 total crosswalks. Regarding lighting quality, above average lighting accounts for 16 percent of the streets, average lighting accounts for 81.9 percent, and below average accounts for 2.1 percent. The areas with the highest percentages of continuous sidewalk as well as the best lighting are the Western Oregon University campus and the business district on Main Street. The least walkable area is immediately around Monmouth Elementary School.
INTRODUCTION AND LITERATURE REVIEW

The human body is built to move. Daniel Lieberman and Dr. Aaron Baggish (2013) argued that the need for physical activity is evolutionary. In order to develop and function optimally, human bodies need the physical stress that comes with being physically active; the human body is not equipped to handle persistent inactivity. Hunters and gatherers walked, ran, dug, climbed, and did everything by hand and farmers work long, hard hours laboring outdoors; yet, today, hardly anyone moves if they don’t have to. People overutilize cars, elevators, escalators, etc. because they have the option. The majority of the United States adult population fails to meet the Surgeon General’s recommendation of accumulating 150 minutes per week of physical activity because people are choosing not to move. We evolved to be physically active not out of want, but out of need; now we need to want to be active. Motivation is essential because physical activity is already a national priority. The human body requires physical activity to thrive, as it evolved to require the stresses of physical activity in order to properly develop. Every system in the human body benefits from regular physical activity and suffers during periods of inactivity; it was never meant to experience copious amounts of inactivity. In order to increase physical activity levels, schools need quality physical education, cities need to encourage and accommodate non-motorized transportations, businesses need to provide incentives for employees who are physically active, and the built environment needs to be conducive to physical activity.
According to the Centers for Disease Control and Prevention [CDC] (2015a), adults need 150 minutes of moderate-intensity aerobic physical activity, 75 minutes of high-intensity aerobic activity, or a combination of the two each week in addition to a minimum of two days of strength training for the full body. Children and adolescents need 60 minutes of physical activity per day, the majority of which being aerobic activity, and also muscle and bone strengthening activities at least three days a week (CDC, 2015b).

However, more than eighty percent of both adults and adolescents are not meeting these minimum guidelines and only one third of children are physically active every day (U.S. Department of Health and Human Services [HHS], 2015). America is in the midst of an obesity epidemic partially due to the low levels of physical activity, and reports have projected that the epidemic will grow steadily worse, with half of the United States population becoming obese by 2030 (The President’s Council on Fitness, Sports & Nutrition, n.d.). While increasing physical activity levels will not necessarily eliminate the prevalence of obesity, increasing an individual’s physical activity level by even the smallest amount increases the health—physical, mental, and cognitive—benefits they receive, regardless of their weight or previous activity level.

There are many physical and physiological benefits from being physically active. These benefits range from reducing an individual’s risk for cardiovascular disease, or preventing disease altogether, to strengthening the body’s various systems. Metabolic syndrome, prevalent in thirty-four percent of adults, is a package of risk factors that increase an individual’s chance of developing cardiovascular disease.
These risk factors include abdominal obesity, high triglyceride levels, low HDL cholesterol, high blood pressure, and high fasting blood sugar or insulin resistance. A diagnosis of metabolic syndrome is given when an individual displays three of the five factors (Ervin, 2009). Additionally, the more factors an individual has, the greater they are at risk for heart disease, stroke, or diabetes (National Institutes of Health & HHS, 2011). Because the primary causes of metabolic syndrome are obesity and inactivity (Mayo Clinic, 2014), increasing physical activity levels is the most effective treatment and prevention.

Abdominal obesity is caused by the accumulation of visceral fat around the abdominal organs. Visceral fat is highly metabolically active and releases fatty acids, inflammatory agents, and hormones that raise LDL cholesterol, triglyceride, and blood glucose levels and increase blood pressure (Harvard T.H. Chan School of Public Health, n.d.). Elevated levels of triglycerides and LDL cholesterol, as well as high blood pressure, contribute to atherosclerosis, which leads to heart disease and other cardiovascular complications (American Heart Association, 2015; Stöppler, 2014). Regular physical activity—along with a healthy, balanced diet—can reduce abdominal obesity and therefore lower triglyceride and LDL cholesterol levels, as well as blood pressure, decreasing an individual’s risk for heart disease and stroke.

With regard to diabetes, physical activity—in correlation with a healthy diet, medications, and stress management—can manage and regulate glucose levels. During physical activity, body cells use glucose to receive the ATP required to be active. Regular physical activity can lower blood glucose without the use of insulin,
which enables those with diabetes to be less reliant on their medications and insulin shots (American Diabetes Association, 2015).

Regular physical activity affects many of the body’s systems, including the musculoskeletal, metabolic, immune, and endocrine systems. The musculoskeletal system encompasses characteristics such as muscle strength and joint structure and function. Physical activity strengthens the body’s muscles, improves balance and coordination, and increases lean muscle mass, which has many advantages, including increased metabolism, improved blood vessel networks, and better skeletal support. Additionally, physical activity is necessary for the stimulation of bone growth, allowing children and adolescents to develop normal skeletal structures and young adults to obtain and maintain optimal bone mass. Regular physical activity maintains the health of joints by producing synovial fluid that lubricates the joints, allowing them to be frictionless and have a full range of motion. Overall, physical activity has a strong impact on the health of the musculoskeletal system and, if performed regularly, produces many benefits (Hiwale, n.d.; HHS, CDC, National Center for Chronic Disease Prevention and Health Promotion, & The President’s Council on Physical Fitness and Sports, 1999).

The metabolic system is simply the body’s metabolism. Basal metabolic rate, or the amount of energy required for the body to maintain homeostasis, is primarily influenced by an individual’s lean muscle mass. Increased lean muscle mass leads to an increased basal metabolic rate. Basal metabolic rate is also influenced, though negatively, by body fat percentage, as fat cells use less energy than other cells (State
Government of Victoria, 2015). Physical activity helps the body maintain or increase lean muscle mass and decreases body fat, ultimately increasing the body’s metabolism.

Physical activity can have both positive and negative effects on the immune system. It boosts the function of natural killer cells, lymphocytes, and other immune system cells. In addition, physical activity stimulates the circulation of lymph, allowing antibodies and white blood cells to be transported around the body quicker. However, high levels of vigorous activity can cause a reduction in T-lymphocyte stimulation, decrease the synthesis of antibodies, and hinder phagocytosis performed by the macrophages, impairing the function of the immune system (Vorvick, 2014; CDC, n.d.).

The endocrine system controls the physiological responses of the body and is affected by physical activity. Physical activity signals the pituitary gland to release human growth hormone, increasing bone and muscle mass and tissue production. The thyroid gland regulates the body’s temperature, heart rate, and blood pressure during physical activity, as well as alertness. The adrenal glands release cortisol and aldosterone. Cortisol controls blood pressure and glucose levels and is an anti-inflammatory agent. Aldosterone regulates sodium and water levels, heart rate, force of contractions, and breaks down stored carbohydrates for energy. Finally, the pancreas controls insulin levels. As discussed previously, physical activity reduces the body’s reliance on insulin (The American Council on Exercise, 2012).

Physical activity has diverse positive effects on physical and physiological health, but these benefits extend beyond the physical realm. Mental and cognitive
health are also affected by physical activity levels. Mental health, which entails emotional, psychological, and social well-being, impacts thoughts, feelings, and actions, including how the body responds to stress. Mental health problems— affecting twenty percent of American adults—alter moods, thoughts, emotions, and behaviors (HHS, n.d.a.; HHS, n.d.b). Depression and anxiety disorders are, among other factors, due to chemical imbalances in the brain and are typically treated with medications that restore balance to the neurochemicals. However, research has demonstrated that physical activity can be as effective as medication at treating and preventing depression and anxiety (Bergland, 2013c; Craft & Perna, 2004).

Depression affects almost seven percent of American adults each year and results from low levels of many neurotransmitters, including serotonin, dopamine, and corticotrophin-releasing hormone (Substance Abuse and Mental Health Services Administration, 2013). Additionally, it is associated with having a smaller hippocampus and a highly active amygdala. Antidepressant medications increase neurotransmitter concentrations in the synapses of the brain, giving the brain enough of a boost to allow it to function normally (Harvard Medical School, 2011). Physical activity works in a similar manner and is explained through five different theories.

The *thermogenic hypothesis* argues that increased body temperature, especially in specific brain regions, following physical activity reduces muscle tension and leads to a feeling of relaxation. The *endorphin hypothesis* suggests that the relief from depression is due to increased concentration of endorphins, which are correlated with positivity and an increased sense of well-being. The *monoamine hypothesis*, the most promising
theory, states that physical activity increases neurotransmitters in the brain that are depleted in an individual with depression. The *distraction hypothesis* argues that physical activity acts as a distractor from the negative thoughts and worries that come with depression and is effective for depression management. Finally, *self-efficacy*—believing in one’s ability to complete a task using necessary skills and having confidence that the desired outcome will be achieved—is enhanced through involvement in physical activity, thus providing the individual with an experience of mastery that will help work towards reducing their depression (Craft & Perna, 2004).

The effects of physical activity do not occur immediately, despite the influx in neurotransmitter concentrations. Research suggests that moods improve as neurogenesis—nerve cell growth and enhancement of nerve networks—occurs. The initial increase in neurotransmitter concentrations stimulates neurogenesis and once these new and upgraded pathways throughout the brain are developed, which can take weeks, the neurotransmitters are able to be transported quicker, thus improving mood and decreasing depression (Harvard Medical School, 2011).

Anxiety, like depression, is caused by neurotransmitter imbalances—namely endorphins, serotonin, and brain-derived neurotropic factor (BDNF)—that are restored through physical activity, but is also due to the individual’s sensitivity to physiological changes in their body and their perception of the situation at hand. Anxiety sensitivity is the tendency to misinterpret situations and sensations, believing that they will have negative outcomes (Anderson & Shivakumar, 2013). Physical activity lessens the severity of an individual’s sensitivity by demonstrating that the
event, such as an increased heart rate, does not signify a threat. After they begin associating the event with physical activity, it becomes something they can control and initiate, building self-efficacy. The individual is able to activate the sympathetic nervous system on their own rather than worrying and allowing the amygdala to exaggerate a harmless situation (Sparkling Life, n.d.b).

Stress plays a role in the development of depression and anxiety disorders. The stress response ultimately increases heart and respiratory rates, which can trigger an anxiety attack. High levels of stress destroy neural pathways and can hinder new cell growth in the hippocampus, causing the hippocampus to shrink, as seen in patients with depression. Stress also drains energy, disrupts concentration, and impairs sleep, leading to higher levels of stress and creating a positive feedback loop. Physical activity releases a flood of neurochemicals that reverses these processes, rebuilding and strengthening the brain (Anxiety and Depression Association of America, n.d.; Harvard Medical School, 2011; Sparkling Life, n.d.c). In their study, Mailey and McAuley (2014) reported that a decrease in stress was associated with an increase in physical activity, but the change was more strongly associated with the increased self-efficacy and self-regulation that came as a result of increasing physical activity.

A longitudinal study conducted over the span of six years concluded that increases in physical activity had a positive impact on depression, anxiety, and burnout over time, demonstrating that the effects of physical activity on mental health are long-term (Lindwall, Gerber, Jonsdottir, Börjesson, & Ahlborg, 2014).
“From a public health perspective, promoting physical activity is a valuable mental health strategy” (Bergland, 2013c, para. 11) and should be incorporated into treatment plans for patients with depression and anxiety.

The benefits of physical activity on cognitive health are also long-term. Zhu et al. (2014) conducted a study exploring the long-term relationship between cardiorespiratory fitness and cognitive function. They had participants perform a treadmill test during the initial exam and then again twenty years later to measure their fitness. Twenty-five years after the first test, the participants were tested on their cognitive abilities, namely verbal memory, psychomotor speed, and executive function. The results demonstrated that the more fit the participants had been as young adults, the better their cognitive function was in their mid-life.

As demonstrated by Naperville Central High School, the fittest school in the nation, the cognitive benefits are immediate, as well. Only three percent of its class of sophomores were overweight at the time Ratey and Hagerman (2013) wrote their book, compared to the thirty percent national average. Additionally, the students in Naperville are some of the smartest in the nation – and world. In 1999, eighth graders in Naperville took an international standards test, the Trends in International Math and Science Study (TIMSS), placing sixth in math and first in science in the world.

Naperville Central High School evolved their physical education classes, transitioning from teaching sports to teaching fitness. They offer a zero-period fitness class where students can come in before school for their physical education class, allowing their minds to be more alert for their morning classes. Students who do not
take the zero-period class are encouraged to schedule their physical education class for the period before their most difficult class. Additionally, in all of the physical education classes, students wear heart rate monitors that gauge the effort they are putting into the class. Instead of being graded on how quickly they can run a mile or how many pushups they can do, they are graded based on the amount of time they spend in their target heart rate zone. Not only does this allow the instructor to ensure students are participating, it also displays the students’ physical activity levels to themselves and others, allowing them to make the association between physical activity and cognition as they witness improvements in their classmates’ and their own academic performance (Ratey & Hagerman, 2013).

Cognition encompasses processes such as attention and memory. The information the brain concentrates on and pays attention to is dictated by past experiences in addition to stimuli such as emotions, threats, or sex. Moreover, the brain is only capable of concentrating on one task for ten minutes at a time before its attention drifts elsewhere, unless something occurs at the ten-minute mark that regains its attention (Medina, n.d.). Despite the complexity of the human brain, it lacks the ability to multitask. Abaté (2008) explained that what most people would consider to be multitasking is the brain switching from one task to the next, focusing its attention solely on one at a time.

The circuits in the brains responsible for controlling attention are regulated by norepinephrine and dopamine. When an imbalance in these neurotransmitters occurs, it results in attention-deficit hyperactivity disorder (ADHD), one of the most
commonly diagnosed disorders in children (Sparking Life, n.d.a). Individuals with ADHD find it difficult to pay attention, have trouble controlling their impulsive behaviors, and/or may be overactive (CDC, 2015c). Normally, during childhood and adolescence, an individual’s cognitive control—their ability to control their thoughts and actions and direct their behavior towards certain goals—are developing and improving. However, in a child with ADHD, this development is hindered. Research suggests, though, that physical activity positively affects cognitive function involved in attention and memory, behavior regulation, and information processing in children with ADHD (Chaddock-Heyman, Hillman, Cohen, & Kramer, 2014; Pontifex, Fine, da Cruz, Parks, & Smith, 2014). Physical activity increases the availability of norepinephrine and dopamine in the brain, allowing concentration and processing to occur (Sparking Life, n.d.a).

Committing processed information to memory—implying that learning has occurred—requires varying levels of effort. Some information is easily remembered and automatically stored in short-term memory. Other information is more difficult and needs to be repeated to be remembered. The neurons that perceived the information the first time need to be stimulated again in order to remember, otherwise they reset themselves and the information is gone. Information remains in short-term memory for twenty to thirty seconds before it is either stored in long-term memory or forgotten. Effectively storing information in long-term memory, however, takes years. The memory is consolidated after repeated exposure and elaborative
encoding, which entails transforming the information into something meaningful or giving it context (Medina, n.d.).

These processes, among others, are improved due to the effects of irisin. Irisin is produced by the brain during aerobic exercise and increases the levels of brain-derived neurotrophic factor (BDNF). BDNF then stimulates neurogenesis—the creation and enhancement of neural pathways—causing the hippocampus to expand and grow, preserving gray matter, and activating genes involved in memory and learning (Bergland, 2013b). A larger hippocampus and more gray matter indicate a healthier brain that is more capable of spatial reasoning and other cognitive tasks and an individual who is less at risk for developing Alzheimer’s disease and dementia. Studies have shown that individuals who are physically active at least twice a week are fifty percent less likely to develop dementia in their later life and sixty percent less likely to develop Alzheimer’s disease (Bergland, 2013a; Medina, 2008; Tolppanen et al., 2015).

Despite the plethora of benefits that come as a result of being physically active, the majority of the United States population fails to meet the national physical activity guidelines. Simply educating people on the benefits of physical activity is not enough to increase their physical activity levels. Advocates of physical activity need to utilize personal stories of success or, if an individual has already increased their physical activity level, draw attention to the changes an individual may see or feel as a result, allowing others to connect with the information and see a real-world application of a change that needs to be made.
However, lifestyles changes are difficult to make and adhere to as adults without previous experience with the change, so influencing children and adolescents to become physically active and maintain that activity level throughout their life is necessary (Valois et al., 2008). Lieberman and Baggish (2013) asserted that “the question we should ask is not whether more Americans should exercise, but how can we help them do it?” (para. 12). In order to be physically active, motivation is vital and physical activity needs to be mandatory and deemed a priority by the nation (Lieberman & Baggish, 2013). By integrating the Socio-Ecological Model and Self-Determination Theory into health discussions and programs, the barriers, influences, and needs related to being physically active are brought to light and are able to be addressed in the appropriate manner, whether it is implementing policies in schools and neighborhoods or effectively motivating individuals.

The Socio-Ecological Model addresses multiple levels of health determinants and interventions. Physical activity, or the lack thereof, is a result of interactions among each of the five levels: individual/intrapersonal, interpersonal, organizational/institutional, community, and public policy. The individual or intrapersonal level contains factors that are unique to the individual, such as gender, genetics, physical activity goals, or time management skills. The interpersonal level consists of social networks and support systems, including family, friends, classmates, or Facebook groups. The organizational or institutional level contains organizations that have rules, regulations, and procedures and could include schools, gyms, fitness centers, sports teams, or the competitiveness and schedules of such organizations, in
addition to companies and businesses in general. The *community level* is the interaction of organizations, institutions, and other networks within a set of defined boundaries, such as the school board meetings, built environment, transportation, or the availability of parks. Finally, the *public policy level* consists of laws and policies, whether they are local, state, national, or global, including physical activity policies in schools and businesses or the laws and regulations that could be implemented (American College Health Association, n.d.).

Far too often, the individual level is spotlighted and considered to be the most influential level of the Socio-Ecological Model when in reality the individual and policy levels should be addressed simultaneously. In order to spark a change within an individual, the change must begin at the policy level and work its way down to the individual level. For example, increasing physical activity levels in a community must first start with a city policy enforcing quality built environments that allow for and encourage physical activity. The policy needs to be specific, identifying priorities and outlining procedures or parameters to follow upon implementation, and those creating the policy need to consider how it will be implemented, evaluated, and funded from the moment they begin to write it, incorporating these components into the description of the policy (Hogan et al., 2014; Howie & Stevick, 2014).

After the policy is mandated, the policies will be integrated into the communities and the community will become an advocate for the policy. Communities can even take part in the writing of the policy after it is announced that
one will be made or in the evaluation of the policy’s implementation (Hogan et al., 2014).

Once the community changes have been made, organizations, such as schools and businesses, will take advantage of the activity-conducive environment. For instance, schools can implement Safe Routes to School or businesses can take business meetings on-the-go.

At the interpersonal level, an individual whose friends, family, or classmates are active are likely to see how it affects their lives and want to implement it in their own. Additionally, children enjoy playing together and sharing what they learned with each other and those around them. They will want to take what they learned in their physical education classes in school and bring it into their lives at home, which is only possible if the environment allows for physical activity to take place. One student from Hopkins Elementary School loved a physical activity club at his school and decided to implement it into his home life. He convinced his family to go on a mile walk every evening and they use it as a chance to spend time together, enjoying nature and having fun as a family (Public Broadcasting Services, 2011). The interpersonal level develops social support, sparking a change on the individual level.

Individuals, after being influenced and supported by those around them, will begin to be physically active on their own. They will be motivated to be physically active for themselves rather than for social interaction or because it is required at school. By working from the policy level down to the individual, it creates a structured environment for the individual to work within to increase their physical
activity levels rather than attempting to do so on their own while battling their personal barriers, whether it is genetics, a disability, or time management skills.

However, while advocating for policy changes and working from the top of the Socio-Ecological Model to the bottom, it is crucial to simultaneously work from the bottom up, addressing the individual level to ensure that individuals are motivated to become physically active and maintain that activity. Without motivation, the change within the individual will falter and they will revert back to their previous lifestyle. As stated in the Self-Determination Theory, motivation buds when three basic needs are present and satisfied, as the trio leads to feelings of enjoyment: competence, autonomy, and relatedness (Selfdeterminationtheory.org, n.d.).

Competence is the need to develop mastery in a task or set of tasks and learn a variety of skills. There are five stages in the development of competence: beginner, advanced beginner, competent, proficient, and expert. Someone who is new to being physically active is considered a beginner. They have no experience and rely on instructions from others in order to be active. As a beginner tries new workouts and adheres to the advice of others, they learn the basics of physical activity, moving to the advanced beginner stage, but they still lean on mentors to determine which types of physical activity are deemed priorities. The competent stage is reached when the individual can create long-term goals regarding their physical activity and determine the most important aspects of being active. While the competent individual lacks speed and fluidity in their decision making, they feel they have mastered the activities they enjoy and are able to perform them with confidence. The individual moves into
stage four, proficiency, when they are able to make decisions with little effort and focus on the priorities of being physically active. Finally, the expert stage is achieved when the individual no longer relies on guidelines or rules to formulate their goals or plans concerning physical activity. As the individual moves from stage to stage, their level of competence increases (Kodesia, 2014).

Autonomy is, essentially, independence. Individuals need to feel in control of their behaviors, goals, and lives and they need to feel that that control has meaning and importance. When an individual is autonomous, they utilize their free will to act according to their beliefs and interests. With regard to physical activity, an autonomous individual is one who develops personal goals related to physical activity and carries out those goals. While they may rely on the help of others to become physically active, they remain physically active without feeling dependent on those around them.

The third key to motivation is relatedness, or social support. Wendel-Vos, Droomers, Kremers, Brug, and Van Lenthe (2007) conducted a study to determine influences of physical activity. One of their findings was that social support and being active with a companion were strong factors in physical activity levels. Heaney and Israel (2008) also explored the effects of social support, arguing that meeting the need for relatedness creates supportive bonds that enhance well-being and health. Social support has the potential to diminish levels of uncertainty, helping individuals to develop a sense of independence and control over their lives (Heaney & Israel, 2008).
The three puzzle pieces of motivation build off of and strengthen each other. Relatedness and competence help strengthen autonomy, autonomy and competence allow people to feel comfortable delving into the relatedness realm, and relatedness and autonomy gives the individual an opportunity to develop competence. Additionally, as individuals grow in these areas and become more motivated, they increase their physical activity level, benefiting their health. Then, as they notice the positive changes in their health, they become more competent and autonomous and turn to their support systems for further encouragement, therefore developing higher levels of motivation and creating a cycle of increasing health and motivation.

It is imperative that wellness policies are created and implemented in education systems to ensure that future generations are physically active, but also that advocates for physical activity focus on individuals, building social support systems for them to develop competence and autonomy. Working from both ends of the Socio-Ecological Model creates policies that work their way down the model to the individual and individuals who develop a passion for physical activity and a desire to make the changes necessary for a policy to be implemented. Using the Socio-Ecological Model and Self-Determination Theory as a framework, the needs of individuals and communities can be pinpointed and evaluated, allowing for appropriate action to take place in order to increase physical activity levels and create a healthier, smarter, and happier nation.

Public health promotion arises not only from health care, but also from education, business, community planning, transportation, and the media. Social
The built environment, defined by C.H. Williams (2007) as physical or manmade features such as sidewalks, street lights, traffic, and parks that impact physical activity, plays a key role in determining whether or not individuals within a community are physically active, especially with respect to their use of walking or biking as a means of transportation. Elements of the built environment that correlate with increased physical activity levels include access to public transportation, the presence of sidewalks, having safe walking routes, and low traffic density. As explained in Healthy People 2020, individuals living in activity-friendly environments are typically more active than those in areas that are not activity-friendly; therefore, monitoring and implementing policies that improve the built environment is a public health priority (HHS, 2015). Walk- and bike-friendly environments encourage people to walk and bike as a means of transportation as well as for leisure time activities.

The CDC promoted healthy city planning and community design through the Health Impact Assessment (HIA), surveillance, evaluation, and research and communications. Successful healthy community design involves thoughtful
development of transportation, architecture, urban planning, and public health law (National Center for Environmental Health, Division of Emergency and Environmental Health Services, & CDC, 2011).

Urban spaces need to be designed for movement; plans for which include active transport (walking, biking), parks, play spaces, and incentives for schools and workplaces that encourage physical activity. Physically active populations have increased productivity, improved academic performance, higher property values, improved health and well-being, and are more economically competitive. A city that prioritizes physical activity in all areas of its citizens’ lives is termed an active city. Active cities display economic, safety, environmental, health, and social benefits. For instance, active cities correlate with business and job growth, lower crime rates, improved air quality, decreased rates of chronic disease, and increased engagement of citizens (Spoon, 2015).

Equitable community development and design impact the ease with which residents can be physically active, allowing them to walk and bike safely, utilize affordable transportation, and seek space for active recreation. Such communities have walking or biking paths to highly frequented areas (grocery stores, jobs, healthcare services, schools, etc.), improve the quality of air as well as the quality of life, and increase economic opportunity and strong social ties. Policies regarding community development and design determine where destinations are located within the community, how much space is provided, and how accessible those areas are (National Physical Activity Plan, n.d.).
The National Physical Activity Plan (n.d.) developed five strategies for increasing a community’s conduciveness for physical activity: (1) design communities with physical activity in mind, (2) change zoning laws to incorporate destinations within residential areas and include walking and biking paths to all destinations, (3) advocate increasing active transportation through funding and policies, (4) base policies on data, and (5) encourage active transportation through initiatives. Strategy 4 of the Transportation, Land Use, and Community Design sector states that connecting destinations and making them more accessible through pedestrian and bike paths will influence the community to turn to walking and biking for transportation (National Physical Activity Plan, n.d.).

Richard J. Jackson (2003) argued, “It is time for a shift to communities intentionally designed to facilitate physical and mental well-being” (p. 1383). When planning new developments and reconstructing old developments, we need to “need to draw upon the unique ability of humans to plan creatively for healthy communities” (Jackson, 2003, p. 1383). In a research study conducted by Ethan M. Berke, Thomas D. Koepsell, Anne Vernez Moudon, Richard E. Hoskins, and Eric B. Larson (2007), “higher walkability scores were associated with significantly more walking for exercise” (p. 486). Their findings suggested that “neighborhood characteristics are associated with the frequency of walking for physical activity” (p. 486). Similarly, Williams (2007) concluded in a research study that, while there is evidence that the built environment and physical activity levels are linked, the evidence on whether or not the built environment promotes this physical activity is
weak; research does indicate, however, that individual and societal factors have strong influences on physical activity.

Therefore, not only do we need to create walk- and bike-friendly communities, but we need to explain the benefits and importance of increased levels of physical activity and provide our communities with examples of how to do so, even sponsor physical activity programs and events for them to attend. Doing so gives them a reason to be physically active, as it provides a way for them to interact socially while being active or to support a cause. It’s also important to encourage individuals to develop support systems—whether it’s their family, a group of friends, or a group of strangers online—to provide them with the nudges they need to continue being active. If we motivate individuals to increase their physical activity levels, especially through the increased availability of walkable and bikeable communities, it will have a positive impact on the quality of our nation’s health.

One such strategy for doing so is Safe Routes to School, a program that strives to increase the number of students that walk or bike to school. The state of Oregon walk zone—the distance around a school in which the school buses do not pick up students—is one mile for elementary schools and 1.5 miles for secondary schools. In 2007, parents of third and fourth grade students at Monmouth Elementary School were surveyed regarding how their students travel to and from school as well as the concerns they have about their students walking as a mode of travel (Brass, 2007). Of these third and fourth graders, 61 percent lived within the walk zone. However, the most common mode of travel overall was automobile.
Furthermore, students were more likely to walk or ride the bus home rather than to school; Brass speculated this was due to parents being at work and therefore unable to pick their student up from school.

With regard to walking, 54 percent of parents indicated that they allow their students to walk or bike to and from school. Seventy-one percent of parents living one half mile away from Monmouth Elementary School allow their student to walk or bike. Sixty-one percent living between one half and one mile allow their student to walk or bike. Forty-six percent living between one and two miles allow their student to walk or bike. Finally, 11 percent of parents living more than two miles from the school allowed their students to walk or bike as a mode of travel (Brass, 2007).

Brass (2007) also surveyed parents regarding their specific concerns about their student walking to school. The primary concern was bad weather (57 percent of parents identified it as a concern). Other concerns included traffic safety (55 percent), fear of crime (48 percent), major streets to cross (48 percent), walking alone (48 percent), speeding cars (48 percent), too far of a distance (30 percent), and unsafe sidewalks and bikeways (25 percent).

PURPOSE OF STUDY AND RESEARCH QUESTIONS

The purpose of the present study is to assess the quality of the built environment of Monmouth, Oregon, with regard to its walkability in order to give understanding to the issue of potential physical activity levels of the community as well as to discuss the environment’s conduciveness for walking, particularly in
relation to Monmouth Elementary School. Additionally, this study aims to create a resource for the public that outlines excellent, good, and poor walking paths.

The research questions are as follows:

1. How walkable is the walk zone of Monmouth Elementary School?
2. What areas are most and least suited for walking?

**METHODS**

This descriptive research study analyzes the walkability of the Monmouth Elementary School walk zone by identifying the locations of sidewalks, crosswalks, and street lights and discussing these in tandem with obstacles to walking safely through Monmouth. Figure 1 features the boundary lines and walk zone for Monmouth Elementary School noted by thick lines and a circle, respectively. The north boundary lines for Monmouth Elementary School are Whitesell Street, just above Burlwood Avenue, and just above Olive Way; the east boundary line is Hogan Road. The residents to the south and west of these boundaries being the majority of the students that are designated to attend Monmouth Elementary School. To determine the boundaries of the walk zone of Monmouth Elementary School, a one-mile radius was measured around the school’s location. This was done using the map available on the Polk County’s webpage and the scale provided on that map (Polk County GIS, 2008).
The assessment of the built environment of the Monmouth Elementary School walk zone uses reliable portions of a validated walkability survey released by Safe Routes to School. The walkability survey identifies specific aspects of the built environment to be rated and described. Such aspects include safe places to walk; quality of the surface, intersections, and lighting; ease of crossing streets; personal safety decisions (crossing at a safe location); ability to follow safety rules; and overall appearance of the neighborhood. The specific elements addressed in the present study are sidewalks, street lights, and crosswalks.

The data collection portion of this assessment occurred between March and May 2018, during which each street within the Monmouth Elementary School walk zone was walked up and down to determine the locations of street lights and
crosswalks as well as whether sidewalk was present on either side of the street. These data were collected at various times and dates over these three months to calculate the differences in lighting based on the distance between the street lights.

**MEASURES**

The first element, sidewalks, was measured by identifying where sidewalk was continuous, discontinuous, and absent by walking up and down each street within the Monmouth Elementary School walk zone and indicating whether or not sidewalk was present. To do so, the presence of sidewalk was coded green on the map and the absence of sidewalk was coded red on the map. If a sidewalk was present along the side of a road that was being walked down, that side of the road on the map was marked green for the distance that the sidewalk spanned. If sidewalk was not present, the distance that the absence spanned was marked red on the map. The distances that the presence or absence of sidewalk spanned was verified using Google Maps at maximum magnification. Discontinuity was measured by observing the frequency with which a sidewalk alternated between green and red on the map.

Street lights were measured by marking the approximate location of street lights on the map. After all the street light locations were identified and the distances between them were measured, a map was coded to demonstrate the quality of lighting as follows:

1. Above average: Street lights are less than 300 feet apart
2. Average: Street lights are between 300 and 400 feet apart (which is the average distance between street corners in Monmouth)

3. Below average: Street lights are greater than 400 feet apart.

Above average lighting was marked on the map as a yellow line spanning the distance of such lighting. Average lighting was marked orange, and below average lighting was marked red.

Crosswalks, the final element being addressed in this study, were measured by marking the location of painted crosswalks at intersections with a purple line on the map. These were divided into five categories: four painted crosswalks at an intersection, three at an intersection, two at an intersection, one at an intersection, and mid-street. The streets and intersections with no crosswalks were not categorized.

Other elements of the built environment that impact the walkability of the Monmouth Elementary School walk zone were noted separately from the map (i.e. sidewalk is cracked or has frequent steep dips) as they were observed while walking up and down the roads of Monmouth.

The percentages of sidewalk qualities were determined for the overall walk zone as well as four individual quadrants. This was accomplished by utilizing the scale on the map used in this study to determine the mileage of continuous, discontinuous, and absent sidewalk. To do so, these three qualities were observed separately. First, the streets with continuous sidewalk were measured in inches on the map and, using the scale provided on the map, these inches were converted to miles. This was done
again for the discontinuous and absent sidewalks. Because there are two sides of each street, the mileage for any given street has twice the amount of sidewalk mileage. The mileages for each individual category were totaled as well as the total overall mileage for the entire walk zone and for each quadrant. To determine percentages, each individual total was divided by the overall total.

![Figure 2: The four quadrants of the Monmouth Elementary School walk zone.](image)

The map was split into four quadrants relatively equal in size, with Catron Street being the vertical border and Jackson Street being the horizontal border, as featured in Figure 2. Quadrant 1 contains the streets north of Jackson Street and west of Catron Street, including the north and west sides of these streets. Quadrant 2 contains the streets north of Jackson Street and east of Catron Street, including the north and east sides of these streets. Quadrant 3 contains the streets south of Jackson
Street and west of Catron Street, including the south and west sides of these streets. Finally, Quadrant 4 contains the streets south of Jackson Street and east of Catron Street, including the south and east sides of these streets.

Finally, the percentages of lighting quality were also determined. This was accomplished by utilizing the scale on the map used in this study to determine the mileage of above average, average, and below average lighting. To do so, these three qualities were observed separately. First, the streets with above average lighting were measured in inches on the map and, using the scale provided on the map, these inches were converted to miles. This was done again for average and below average lighting. The mileages for each individual category were totalled as well as the total overall mileage for the entire walk zone. To determine percentages, each individual total was divided by the overall total.

DEFINITIONS

For the purpose of this study, continuous sidewalk is sidewalk that spans at least a block (street corner to street corner) without any disruption. Discontinuous sidewalk is sidewalk that changes from present to absent within a block or has frequent changes over a larger distance. Absent sidewalk is sidewalk that is not present for at least a block. Other terms are defined in the glossary located in Appendix 2.
DELIMITATIONS

The present study focuses on the Monmouth Elementary School walk zone rather than all of Monmouth. Because the walk zone is the area in which students cannot ride the bus, these are the students that are most likely to walk to school (thus the area is deemed the walk zone) and therefore most in need of access to safe routes to walk to school. Furthermore, the focal point of this study is only Monmouth Elementary School rather than all of Central School District due to personal connection to the area and the school as well as the desire to conduct an in-depth analysis of one school instead of incomplete analyses of multiple schools.

This study measures sidewalks by indicating whether they are present or absent. The original intention was to have a third qualifier: present but in poor condition. However, as data were collected, it was determined that this analysis piece was too inconsistent and not reliable for the purposes of this study; therefore, it was eliminated from the analysis. Instead, the presence and absence of sidewalk was monitored and any sidewalk in poor condition was noted separately to be discussed as obstacles to walkability.

RESULTS

SIDEWALKS AND CROSSWALKS

Figure 3 illustrates the locations of sidewalks and crosswalks within the Monmouth Elementary School walk zone. The presence of sidewalk is indicated by a
green line and the absence of sidewalk is indicated by a red line. Crosswalk locations are indicated by purple dashes across the intersections at which they occur.

Figure 3: Presence of sidewalks and crosswalks within the Monmouth Elementary School walk zone.
Figure 4 depicts the percentages of continuous, discontinuous, and absent sidewalks within the entire Monmouth Elementary School walk zone. Continuous sidewalk accounts for 56.2 percent of all sidewalks in this zone. Discontinuous sidewalk accounts for 30.2 percent and absent sidewalk accounts for 13.6 percent.

Figure 4: Sidewalk presence in the Monmouth Elementary School Walk Zone

Figure 5 depicts the percentages of each sidewalk category in Quadrant 1 of the Monmouth Elementary School walk zone, which contains the streets north of Jackson Street (including the northern side of Jackson Street) and west of Catron Street (including the western side of Catron Street). Continuous sidewalk accounts for 60 percent of the total sidewalk presence. Discontinuous sidewalk accounts for 35.1 percent and absent sidewalk accounts for 4.8 percent.
Figure 5: Sidewalk presence in Quadrant 1 of the Monmouth Elementary School walk zone

Figure 6: Sidewalk presence in Quadrant 2 of the Monmouth Elementary School walk zone
Figure 6 illustrates the presence of sidewalk within Quadrant 2, which encompasses the streets north of Jackson Street and east of Catron Street, including the northern and eastern sides of these streets. Continuous sidewalk accounts for 40.9 percent of all sidewalk within Quadrant 2. Discontinuous sidewalk accounts for 43 percent and absent sidewalk accounts for 16.1 percent.

Figure 7 displays the percentages of sidewalk qualities in Quadrant 3, which includes the streets south of Jackson Street (as well as the southern side of Jackson Street) and west of Catron Street (as well as the western side of Catron Street). Continuous sidewalk accounts for 63.9 percent of all sidewalk within this quadrant. Discontinuous sidewalk accounts for 14.8 percent and absent sidewalk accounts for 21.3 percent.

![Sidewalk Presence in Quadrant 3](image)

Figure 7: Sidewalk presence in Quadrant 3 of the Monmouth Elementary School walk zone
Figure 8 illustrates the percentages of sidewalk qualities within Quadrant 4 of the Monmouth Elementary School walk zone. This quadrant contains the streets south of Jackson Street and east of Catron street, including the southern and eastern sides of these streets. Continuous sidewalk accounts for 57.4 percent of all sidewalk within this quadrant. Discontinuous sidewalk accounts for 27.7 percent and absent sidewalk accounts for 14.9 percent.

**Sidewalk Presence in Quadrant 4**

![Pie chart showing sidewalk presence in Quadrant 4]

Figure 8: Sidewalk presence in Quadrant 4 of the Monmouth Elementary School walk zone

There are 75 total crosswalks within the Monmouth Elementary School walk zone. Table 1 divides them by type: 4 crosswalks at an intersection, 3 at an intersection, 2 at an intersection, 1 at an intersection, and mid-street.
Table 1: Crosswalks in the Monmouth Elementary School walk zone.

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
<th>Location</th>
<th>Quadrant(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 at an intersection</td>
<td>10</td>
<td>Jackson Street/Monmouth Avenue</td>
<td>1, 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main Street/Monmouth Avenue</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main Street/Warren Street</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main Street/Knox Street</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main Street/Broad Street</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main Street/Ecols Street</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main Street/Catron Street</td>
<td>3, 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main Street/Pacific Avenue</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clay Street/College Street</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Church Street/Sacre Lane</td>
<td>2</td>
</tr>
<tr>
<td>3 at an intersection</td>
<td>2</td>
<td>Stadium Drive/Monmouth Avenue</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Monmouth Avenue/Church Street</td>
<td>1</td>
</tr>
<tr>
<td>2 at an intersection</td>
<td>3</td>
<td>Jackson Street/Warren Street</td>
<td>1, 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clay Street/Monmouth Avenue</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clay Street/Warren Street</td>
<td>3</td>
</tr>
<tr>
<td>1 at an intersection</td>
<td>7</td>
<td>Campus Bypass/Knox Street</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jackson Street/College Street</td>
<td>1, 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pacific Avenue/Church Street</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pacific Avenue/Madrona Street</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main Street/Heffley Street</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jackson Street/Sacre Lane</td>
<td>2, 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Margaret Street/Kayla Way</td>
<td>2</td>
</tr>
<tr>
<td>Mid-street</td>
<td>16</td>
<td>Stadium Drive (5)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Campus Bypass (1)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Monmouth Avenue (8)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Church Street (1)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Main Street (1)</td>
<td>2</td>
</tr>
</tbody>
</table>
Figure 9: The quality of lighting in the Monmouth Elementary School walk zone

Figure 9 illustrates the quality of lighting within the Monmouth Elementary School walk zone. A yellow line indicates that the street lights are less than 300 feet
apart (above average lighting). An orange line indicates average lighting, meaning street lights are located every 300 to 400 feet, or the average distance between street corners in Monmouth. A red line indicates below average lighting: street lights are more than 400 feet apart.

Figure 10 depicts the percentages of lighting quality within the Monmouth Elementary School walk zone. Above average lighting accounts for 16 percent of the streets. Average lighting accounts for 81.9 percent and below average accounts for 2.1 percent.

Figure 10: Lighting quality in the Monmouth Elementary School walk zone
DISCUSSION

SIDEWALKS AND CROSSWALKS

In the entire walk zone of Monmouth Elementary School, 56.2 percent of sidewalk is continuous, 30.2 percent is discontinuous, and 13.6 percent is absent. While 54 percent of Monmouth Elementary School student’s parents indicated in a Safe Routes to School survey that they allow their students to walk or bike to school, the parents’ concerns about poor sidewalk conditions are validated (Brass, 2007). The students most likely to walk to school--those living immediately around Monmouth Elementary School--are presented with the worst sidewalk conditions: discontinuity, absence, obstacles on the sidewalk paths, and tripping hazards on the sidewalk paths. On the other hand, the students that reside in areas with better walkability have to cross busy streets and then walk along streets that intermittently have sidewalk.

Quadrant 1, which encompasses the streets north of Jackson Street and west of Catron Street, is 60 percent continuous sidewalk, 35.1 discontinuous sidewalk, and 4.8 absent sidewalk. Compared to the other three quadrants, Quadrant 1 has the second-most continuous sidewalk, the second-most discontinuous sidewalk, and the least absent sidewalk. This quadrant contains the Western Oregon University campus as well as residential neighborhoods.

Nearly all of the Western Oregon University campus has continuous sidewalk lining both sides of the streets, with the exception of Stadium Drive, a small portion of Jackson Street, Campus Bypass, and Knox Street. However, each of these streets has sidewalk on at least one side of the road at all times and there are no instances of
sidewalk being absent. Additionally, all the crosswalks that are located in Quadrant 1 are on Western Oregon University’s campus, some at intersections, but most mid-street.

The residential neighborhoods in Quadrant 1, on the other hand, contain all three sidewalk qualities. The absent sidewalk that accounts for 4.8 percent of Quadrant 1 is derived from Hassen Street, a portion of Gentle Avenue, Knox Street between Gentle Avenue and Winegar Avenue, and Fleischman Lane—all of which are within the residential neighborhoods. The remainder of these neighborhoods are about equally divided between discontinuous and continuous sidewalks, with 7 streets being entirely continuous from start to end.

Quadrant 2—north of Jackson Street and east of Catron Street—is 40.9 percent continuous sidewalk, 43 percent discontinuous sidewalk, and 16.1 absent sidewalk. Compared to the other three quadrants, Quadrant 2 has the least continuous sidewalk, the most discontinuous sidewalk, and the second-most absent sidewalk. This quadrant contains Monmouth Elementary School and residential neighborhoods.

Quadrant 2 has little sidewalk, especially when compared to the other quadrants. The majority of this area is discontinuous sidewalk, with the disruptions in continuity occurring for large distances. For instance, Alberta Avenue is one of the discontinuous streets—and is discontinuous through its entirety. There are three small sections of present sidewalk on this street and the remainder has no sidewalk. The areas with continuous sidewalk are the newer neighborhood northeast of Monmouth
Elementary School, Pacific Avenue (the highway that cuts through the center of the city), and one side of Powell Street and Church Street.

Regarding crosswalks, Quadrant 2 has few. There are 4 at the intersection of Church Street and Sacre Lane, which is the intersection leading into Monmouth Elementary School’s parking lot. There are also 4 single crosswalks: one north of the school that leads into the field behind the school (Margaret Street and Kayla Way), one east of the school that crosses a busy street (Main Street/Monmouth Independence Highway), one south of the school that crosses a relatively busy street with poor visibility (Jackson Street and Sacre Lane), and one west of the school that crosses the highway (Pacific Avenue and Church Street). The crosswalks at the intersection of Church Street and Sacre Lane have crossing guards to control traffic in order for students to cross quickly and safely, as well as the crosswalk on Pacific Avenue and Church Street.

Quadrant 3, composed of the streets south of Jackson Street and west of Catron Street, is 63.9 percent continuous sidewalk, 14.8 percent discontinuous sidewalk, and 21.3 percent absent sidewalk. Compared to the other three quadrants, Quadrant 3 has the most continuous sidewalk, the least discontinuous sidewalk, and the most absent sidewalk. This quadrant contains residential neighborhoods and the business district.

There are three major discontinuous streets in Quadrant 3: most of Stadium Drive, all of Gwinn Street, and some of Broad Street. There are other less significant instances of discontinuity on Jackson Street, College Street, and Ecols Street, but
there is little discontinuous sidewalk in Quadrant 3 compared to the other quadrants. These sidewalks are all in residential neighborhoods.

Concerning absent sidewalk, these occur in residential neighborhoods, as well. There are at least eight streets with large spans of absent sidewalk, the most notable being Ivy Lane, McDonald Lane, Cherry Lane, and Washington Lane, as these have no sidewalk in their entirety. The remaining instances of absent sidewalk span for at least a block along an otherwise continuous street. These lapses in sidewalk presence account for at least one fifth of the sidewalk space in Quadrant 3, the most absent sidewalk out of all the quadrants.

Quadrant 3 also has the most continuous sidewalk compared to the other quadrants. This sidewalk spans across the business district on Main Street and its surrounding streets as well as all the way down Monmouth Avenue and most of the remaining streets. In terms of continuity, Quadrant 3 not only has the most, but also has the most streets that are nearly entirely continuous.

With regard to crosswalks in Quadrant 3, there are four at each intersection on Main Street from Monmouth Avenue to Catron Street, as well as a four-way crosswalk at the intersection of College Street and Clay Street as well as Jackson Street and Monmouth Avenue. There are also three intersections with two crosswalks and one intersection with one crosswalk.

Quadrant 4 is the streets south of Jackson Street and east of Catron Street. This quadrant is 57.4 percent continuous sidewalk, 27.7 percent discontinuous sidewalk, and 14.9 percent absent sidewalk. In comparison to the other three
quadrants, Quadrant 4 has the third-most percentage of each sidewalk quality. This quadrant is primarily composed of residential neighborhoods, although a few blocks are dedicated to business.

The majority of the continuous sidewalk in Quadrant 4 is located in the streets south of Bentley Street and east of Heffley Street, containing about 11 streets with continuous sidewalk. Martin Way has continuous sidewalk through its entirety, as does Richards Court, Rice Lane, Ballard Drive, and Emerson Lane. The other continuous streets within this portion of Quadrant 4 are continuations of streets that have discontinuous and absent sidewalk. Jacobson Way and Jacobson Court--streets north of the previously listed continuous streets--are also continuous in their entirety. All of these streets are within the residential neighborhoods.

The remainder of the continuous sidewalk in Quadrant 4 occurs intermittently with discontinuous and absent sidewalk. For instance, Main Street is continuous along its north side, but its south side has two brief disruptions in continuity and then the sidewalk disappears altogether on that side until the intersection with Price Lane. There is also continuity along Catron Street and Pacific Avenue near Jackson Street as well as along Clay Street, Madrona Street, Arwater Street, and Southgate Drive. These streets are in both the residential neighborhoods as well as the small portions of the business district that are present in Quadrant 4.

Less than 30 percent of the sidewalk in Quadrant 4 is discontinuous. This discontinuity is primarily along Dalke Street, Craven Street, Heffley Street, Madrona Street, Clay Street, and the south side of Jackson Street. Nearly all of the
discontinuous sidewalk along these streets is in residential neighborhoods, with the exception of Clay Street between Pacific Avenue and Craven Street, which has some businesses to the west and residences to the east.

All of the absent sidewalk--accounting for just under 15 percent of all the sidewalk in this Quadrant--is in residential neighborhoods with the exception of the absent sidewalk along Pacific Avenue, which does not have businesses or residences. The absences of sidewalk are on Davis Lane, Price Lane, High Street, portions of Heffley Street and Bentley Street, Wilmont Court, Scott Street, and Josephine Street as well as along the south side on Main Street east of Heffley Street.

Regarding crosswalks in Quadrant 4, there are two intersections that have four crosswalks and three intersections with one crosswalk each. The intersections of Main Street and Catron Street as well as Main Street and Pacific Avenue have four crosswalks. Additionally, the crosswalks at the Main Street and Pacific Avenue intersection are the only crosswalks that are controlled by lights, as these crosswalks occur at a four-way stoplight. The three intersections with one crosswalk each are Pacific Avenue and Madrona Street, Main Street and Heffley Street, and Jackson Street and Sacre Lane (this one branches into Quadrant 2). In the hours immediately before and after school, the crosswalk at Main Street and Heffley Street has a crossing guard to control traffic and allow students to cross safely and in a timely manner.
LIGHTING

The Monmouth Elementary School walk zone primarily has average lighting, meaning that the street lights are between 300 and 400 feet apart, or the average distance between street corners in Monmouth. Average lighting accounts for 81.9 percent of all the streets. Above average lighting--street lights are less than 300 feet apart--accounts for 16 percent and below average lighting--street lights are more than 400 feet apart--accounts for 2.1 percent.

The streets with above average lighting are primarily surrounding the Western Oregon University campus: Stadium Drive between Monmouth Avenue and Jackson Street, Monmouth Avenue between Gentle Avenue and Main Street, Campus Bypass, Church Street between Stadium Drive and Monmouth Avenue, and Jackson Street between Marr Court and Warren Street. The remaining streets with above average lighting are Catron Street around the Monmouth Police Station and newer apartment buildings, Warren Street next to a public park, along the business district on Main Street and Pacific Avenue, and two small portions of residential neighborhoods (Heffley Street between Main Street and Jackson Street as well as Margaret Street east of Kayla Way and the half of Mickey Lane that runs north to south).

Below average lighting occurs only in two segments: Pacific Avenue north of Olive Way and Pacific Avenue south of Gwinn Street. Both of these segments are leading out of Monmouth and do not have residences or major businesses along them. The remainder of Monmouth has average lighting that primarily encompasses residential neighborhoods.
**OTHER WALKABILITY FACTORS**

In addition to the sidewalks, crosswalks, and lighting being evaluated in this study, other factors to walkability were noted. The most common obstacles in the Monmouth Elementary School walk zone were those that impeded one’s ability to physically walk on the sidewalk that was present. These obstacles included basketball hoops, cars, and trash bins that blocked the sidewalk in most of the residential neighborhoods. Additionally, on the east side of High Street north of Powell Street, telephone poles are stationed in the sidewalk every 200 feet or so that a pedestrian would have to maneuver around while walking on the sidewalk. Another factor that impacted walkability was cracks and steep declines in sidewalk. These features negatively affect walkability by posing safety risks, as many of these cracks and declines are tripping hazards.

Obstacles such as these encourage the pedestrian to walk on the street rather than on the sidewalk provided in order to avoid such barriers. Furthermore, many vehicles in residential areas are parked along the side of the road. When coupled with the above obstacles and/or discontinuous or absent sidewalk, vehicles parked on the side of the road increase the distance that a pedestrian has to travel into the street in order to minimize barriers, thus decreasing the distance between pedestrian and vehicular traffic and, therefore, safety.
**THEMES**

Four major themes are observed from the data on Figures 3 and 9. Theme 1 is characterized by continuous sidewalk and above average lighting. Theme 2 is characterized by primarily continuous sidewalk with some continuity breaches as well as average to above average lighting. Theme 3 is characterized by primarily continuous sidewalk with some continuity breaches and average lighting. Finally, Theme 4 is characterized by discontinuous sidewalks and average lighting.

Theme 1 is located in Quadrant 1 in the business district along Main Street between Monmouth Avenue and Pacific Avenue. On this street, the sidewalk is continuous, street lights occur every 150 to 300 feet, and there are crosswalks at every intersection. This small section of the Monmouth Elementary School walk zone—a half mile stretch on one single street—is the most suited for walking.

Theme 2 is located on or immediately around the Western Oregon University campus in Quadrant 1. The sidewalk is primarily continuous, though there are a few sections of discontinuous sidewalk, but there is always sidewalk on at least one side of the street. Street lights occur every 150 to 300 feet—closer to 150 feet along Monmouth Avenue. Crosswalks are located at nearly every intersection and multiple times between intersections along Monmouth Avenue and Stadium Drive. Western Oregon University’s campus is the second-most walkable area of the Monmouth Elementary School walk zone.

Theme 3 applies to the newer neighborhoods, which are present in all four quadrants, but are most prevalent in sections of Quadrants 3 and 4. The sidewalk in
newer neighborhoods is primarily continuous, though there are some brief disruptions to the continuity. Crosswalks are minimal; the presence of crosswalks in these areas correlates with busier streets. The newer neighborhoods also have average lighting, meaning there are street lights on every street corner and every 300 to 400 feet on streets that span greater distances.

Finally, Theme 4 is present in older neighborhoods, which, like the newer neighborhoods, are present in all four quadrants, but Theme 4 is most prevalent in Quadrant 2. The older neighborhoods feature primarily discontinuous sidewalks, such as in the streets northwest of Monmouth Elementary School. Like Theme 3, there are few crosswalks in the older neighborhoods and their purpose is to allow pedestrians to safely cross busy streets. These neighborhoods have average lighting, just like the newer neighborhoods.

CONCLUSION AND RECOMMENDATIONS

The walkability of Monmouth is better suited for business rather than Monmouth Elementary School students. The best walkability is located around the business district surrounding Main Street as well as the Western Oregon University campus. These areas have little to no gaps in sidewalk continuity and have street lights that range from less than 150 feet apart up to 300 feet apart. Additionally, there are crosswalks at most intersections as well as mid-street. A pedestrian can travel with ease and safety in these areas.
On the other hand, the streets immediately surrounding Monmouth Elementary School are the least walkable. The sidewalk is primarily discontinuous, though there are sections that are continuous and others that are absent, as evidenced by the percentages presented in Figure 6. Furthermore, there are few crosswalks in this area. The intersection of Sacre Lane and Church Street, which leads into the elementary school parking lot, has four crosswalks and each is monitored by a crossing guard. Though there are four remaining crosswalks in this area, three are primarily present as a means for pedestrians to safely cross busy streets (Pacific Avenue, Jackson Street, and Main Street). One last crosswalk is located north of Monmouth Elementary School and allows students to cross Margaret Street to enter school property through a path leading to the field. Finally, lighting in the area surrounding Monmouth Elementary School is average: street lights are present at every street corner and, if a street spans for more than 400 feet without an intersection, there are street lights every 300 to 400 feet.

Brass (2007) surveyed the parents of Monmouth Elementary School students regarding the methods that would most likely increase their comfort level with their student walking or biking to and from school. Their responses included having students walk with other students and/or parents, providing training for students regarding traffic and pedestrian safety, increasing the police enforcement of school zones, reducing the traffic around the school, having walking paths that separate the students from traffic, and improving sidewalk quality (fixing cracks, adding new sidewalk to maintain continuity, etc.).
The students’ ability to walk safely to school benefits the whole community. As the number of students who walk increase, the amount of traffic surrounding the school decreases, which, in turn, increases the safety and accessibility of walking as well as reduces the amount of greenhouse gases released during the hours that parents are dropping off and picking up their students. Furthermore, if parents and community members are enabling and encouraging students to walk to and from school, there is a stronger sense of community, which can lead to improved sidewalks and therefore improved safety and increased neighborhood values (Oregon Safe Routes to School, 2017).

Physical activity benefits communities as well as individuals. Every system in the human body responds positively to physical activity, including mental and cognitive functions. Adults need 150 minutes of moderate-intensity aerobic physical activity and children need 60 minutes of physical activity per day, though the positive effects of physical activity can be seen at lower levels (CDC, 2015a; 2015b). However, more than eighty percent of both adults and adolescents are not meeting these minimum guidelines and only one third of children are physically active every day (HHS, 2015). Increasing physical activity levels in the community can start by improving the walkability of its streets, as this provides safe and convenient paths for physical activity.

This study assessed the walkability of the Monmouth Elementary School walk zone and determined the areas that are best and least suitable for walking. Walkability was determined by analyzing sidewalks, crosswalks, and street lights and was
discussed as percentages by quadrant as well as in four major themes. These themes relate to the continuity of sidewalk combined with the quality of lighting and were the basis in determining the most and least walkable areas within the Monmouth Elementary School walk zone. The areas with the highest percentages of continuous sidewalk as well as the best lighting are the Western Oregon University campus and the business district that lines Main Street. The least walkable area—that with the least continuous sidewalk and average lighting—is immediately around Monmouth Elementary School. This begs the question: Monmouth, most walkable for who?
APPENDIX 1: Safe Routes to School Walkability Assessment

Use this Walkability Checklist to assess the routes you've mapped or walked. The items below will help you think about how you feel safe and comfortable along the route, and if there needs to be changes to the suggested walking routes for the employees. Most walking routes will not have all of the items listed below, but it is important to assess whether employees will overall feel safe and comfortable walking along the routes.

**Sidewalks**

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the sidewalk wide enough for wheelchairs or people walking two or three abreast?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are sidewalks clear of weeds, yard debris, signs, poles, and cars?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Is there enough space between traffic and the sidewalk?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Is there on-street parking to buffer you from traffic?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Are the sidewalks in good condition, without any large cracks or dips?</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

**Crosswalks**

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are there clearly marked crosswalks?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Traffic**

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there a crossing signal?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Did the signal give you enough time to cross the street?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Can you see oncoming traffic while standing on the sidewalk before you cross the street?</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

**Overall surroundings**

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are cars following the speed limits?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Did you feel safe?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Is there adequate street lighting?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Are the streets and sidewalks free of litter and trash?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Are there street trees that provide shade?</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
APPENDIX 2: Glossary

**Above average lighting**: street lights occur more frequently than 300 feet

**Absent sidewalk**: sidewalk that is not present for at least a block.

**Average lighting**: street lights occur every 300 to 400 feet, which is the average distance between street corners

**Below average lighting**: street lights occur less frequently than 400 feet

**Built environment**: physical features of an area, typically manmade, that impact the activity levels of residents

**Continuous sidewalk**: sidewalk that spans at least a block (street corner to street corner) without any disruption

**Discontinuous sidewalk**: sidewalk that changes from present to absent within a block or has frequent changes over a larger distance

**Safe Routes to School**: a program that supports active transportation to school and aims to increase the number of students who walk or bike to school

**Walkability**: the ease with which a pedestrian can walk safely on a sidewalk

**Walk zone**: the area in which school buses do not pick students up
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