INCORPORATE NUDGES INTO WALKABILITY DESIGN

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To my family and all my friends.

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ABSTRACT

Chen, Jun M.S., Purdue University, August 2020. Incorporate Nudges into Walkability Design. Major Professor: Lehto X. Professor.

The rising inactive lifestyle highlights the need to find efficient ways to tackle this worldwide lousy habit. Conventionally, polices of resolving healthy issues such as smoking and overeating focus on providing regulations and information, drawing on the assumption that people will change behavior when they consciously realize the harms and benefits. However, policy interventions have only shown limited success. On the other side, nudging, which assumes people act subliminally and aims to steer people in the right direction without limiting their freedom of choice, is suggested as a promising approach in lessening healthy issues. However, nudging interventions have not received sufficient attention in research so far, especially with regards to walkable designs that lead people to intend to walk instead of taking motor vehicles.

To bridge this gap, innovatively, the present study incorporates nudging techniques into walkability design. Nudging techniques include priming, salience, and norms. Priming is a phenomenon whereby exposure to one stimulus influences a response to a subsequent stimulus, without conscious guidance. The present study primed participants with walking shoes in advance, expecting they have higher intention in walking in later experiments. Salience bias predisposes individuals to focus on items that are more prominent or emotionally striking and ignore those that are unremarkable. In order to generate salience bias, sidewalks of a street view on a black-and-white sketch were highlighted with colors. Then, the study displays the sketch with colored sidewalks to participants, expecting those with salience bias have a higher

intention to walk. Norms are typical patterns of behavior, generally accompanied by the expectation that people will behave according to the pattern. The norm in this study delivered the information that most tourists are walking, expecting a participant who received the information will act consistently with the majority.

The research is based on a carefully designed online questionnaire with scenario-based experiments where participants imagined to be tourists. Research results reveal: 1) priming with walking shoes has significant effects on inspiring people to walk, 2) salient sidewalks nudge people to walk and warm colors like red even have more potential in encouraging walking, and 3) descriptive norms have potent effects on nudging walking, especially when added with identification information. Further, three mediators were identified to bridge the effect of salience on walking intention, namely visibility, excitement, and enjoyment. Visibility represents how noticeable the sidewalks are. Excitement indicates colored and un-colored sidewalks bring expected exciting or boring experience. Enjoyment is the degree of pleasure that participants perceived when imaging to walk on the sidewalks. Collectively, visibility, excitement, enjoyment, prime, and norms together play crucial roles in nudging people to walk. Additionally, females, exercise lovers, and hospitality and leisure industry workers tend to have higher intentions in walking while traveling.

Theoretically, the thesis adds new knowledge to interventions and deconstructions of tourists' walking intentions. Additionally, the study contributes to the refinement of descriptive norms and the literature of social comparison. Practically, the study implies that wellness resources need to be easily noticed by the public so as to make optimal use of healthy support. It also alarms tourism practitioners that besides improving tourists' health, wellness resources can become a pull factor of the tourist attraction and thereby bring tourism economic benefits.

1. INTRODUCTION

1.1 Health status quo

Do you exercise often? Do you rarely participate in sports because of the busy pace of work or study? Studies have reported that physical inactivity is prevailing around the world (Van Dyck et al., 2013). Over 30% of the adults in 122 countries were found adopting sedentary lifestyles (Guthold, Ono, Strong, Chatterji, & Morabia, 2008; Parks, Housemann, & Brownson, 2003).

Unfortunately, the lack of exercise has invoked serious social problems. First, inadequate physical activity leads to severe public health issues, including obesity, diabetes, cardiovascular disease, and stroke (Bauman, Bellew, Vita, Brown, & Owen, 2002; Owen, Humpel, Leslie, Bauman, & Sallis, 2004). Worse still, health issues are considerable contributors to economic costs, including medical expenses and lost productivity. As reported, in the United States, obesity and related diseases are leading causes of the total cost ($114 billion) of healthcare (Tsai, Williamson, & Glick, 2011; Y. C. Wang, McPherson, Marsh, Gortmaker, & Brown, 2011). Moreover, physical in-activity engenders premature mortality. In the year 2018, the Centers for Disease Control and Prevention (CDC) attributed a significant proportion of deaths (8.3%) to inadequate levels of physical activity (Carlson, Adams, Yang, & Fulton, 2018).

The public health condition is deteriorating. Institutions, social groups, and individuals urgently need to explore ways to save health. We must realize that only when our social members are healthy can society gains efficient production and a stable

environment, especially in developed societies like the United States. It was reported that people in developed countries are more likely to take a sedentary lifestyle than people in developing countries (Dumith, Hallal, Reis, & Kohl III, 2011). Notably, the figure for physical in-activity increased to neatly 50% in the USA (Dumith et al., 2011). In a nutshell, for a well-built society and a healthy self, we must work together to improve the public health and reverse the dire status quo.

1.2 Physical activities to improve health

Regularly participating in physical activity is one crucial way to enhance body quality. Physical activities consist of three types: light-intensity, moderate-intensity, and vigorous-intensity. Light intensity activities require standing up and moving around, either in the home or workplace, such as working at a standing workstation. Moderate intensity activities expect a little more effort, but one can still talk while doing them, such as brisk walking and recreational swimming. Vigorous-intensity activities lead to hard breathing, or puffing and panting, such as aerobics and jogging. People tend to stick to light- and moderate-intensity activities because they require less effort. Some of them even can be achieved through planned leisure activities and day-to-day movement, such as taking a walk after the meal and walking briskly to catch a bus. In contrast, high-intensity exercise requires more investment, unintentionally increasing the resistance to sustainable participation in the activity.

Walking has been considered the most appreciated exercise among light- and moderate-intensity activities (Hayashi et al., 1999; Manson et al., 1999). For one thing, walking is a safe physical activity. It reduces health care costs with only a modest increase in the number of injuries (I.-M. Lee & Buchner, 2008; Pate et al., 1995). For another, walking is with high feasibility. As long as there is a road, people can take up the sport of walking. Third, walking effectively decreases rates of chronic diseases and contributes significantly to our body quality (Cole, Leslie, Bauman, Don-

ald, & Owen, 2006; Rafferty, Reeves, McGee, & Pivarnik, 2002). It was reported that walking reduced the risk of cardiovascular events by 31% and decreased the risk of death by 32%. These benefits were equally robust in men and women (*Walking: Your steps to health - Harvard Health*, n.d.). Moreover, walking is also a crucial foundation for the sustainable city and sustainable community, for it is considered a "green" mode of transport that reduces congestion and has low environmental impacts such as conserving energy without air and noise pollution (Forsyth & Southworth, 2008). Thus, in all respects, walking becomes the best exercise.

1.3 Tourist demand for wellness resources

As reported by Global Wellness Institute (2020a), the wellness industry grows nearly twice as fast as that of the global economy. The industry revenues reached $4.5 trillion in 2018, witnessing a triumph ascent over the past decade. Outstandingly, wellness tourism has become one of the most fast-growing sectors of the wellness industry, leading the whole industry in revenue growth (Statistics and Facts, 2018).

Wellness tourism consists of trips associated with the pursuit of maintaining or enhancing personal wellbeing (Global Wellness Institute, 2020b). It focuses on serving wellness-minded consumers by providing natural assets, physical and mental activities (Wellness Tourism Association, 2020). The revenue growth of wellness tourism was more than twice as fast as that of the tourism industry, growing 6.5% annually from 2015 to 2017 (Global Wellness Institute, 2018). The extremely high rate of industry revenue growth reflects the increasing number of wellness-minded tourists.

In response to the wellness-minded tourists, tourism and hospitality businesses keep providing health resources (Global Wellness Institute, 2018). For instance, Zurich Airport in Switzerland offers rentals for inline skates, bicycles, and Nordic walking poles, to help travelers achieve exercise in the conservation area just outside

the airport. Hilton Hotels and Resorts has introduced its "Five Feet to Fitness" program that provides over 11 different fitness equipment in guest rooms. The Genting Dream, part of the Dream Cruises line in Asia, has a 4,000 square-meter spa with all of the latest Western and Asian spa treatments, in addition to a first-rate gym, fitness studio, and yoga and Pilates classes. In a nutshell, health-oriented facilities and projects are springing up in the tourism and hospitality industry. However, little attention was paid to walking-oriented wellness resources.

In tourism and hospitality, walking deserves its lost attention. Because, firstly, walking can not only bring tourists health benefits but improve their travel experience. Studies (Ujang & Muslim, 2014; Mansouri & Ujang, 2016; Farkić, Perić, Lesjak, & Petelin, 2015) found walking is correlated to the tourist experience. It is constructive to enhance tourists' authentic experience and establish emotional connections between the tourists and the traveling destination (Ujang & Muslim, 2014). Most importantly, if tourists are willing to choose walking as a means of travel, the whole industry can be benefited from multi-faceted aspects (*Walking Tourism – Promoting Regional Development*, 2019), including 1) walking-lover markets, 2) complements to local traffic resources, 3) "pull" factors that attract wellness-mind tourists, 4) sustainability to natural assets and local environment, and 5) opportunities to promote the relationship between tourists and residents. Therefore, as a unique and advantaged health resource, walking needs to be deeply integrated into tourism activities for the sake of satisfying the tourist demand, supporting the tourist experience, and further boosting the tourism industry.

1.4 Research objectives and questions

This thesis aims at finding ways to engage tourists in walking. To achieve the goal, two concepts are introduced, namely walkability and nudging. Walkability is the ability of the environment to provide people with a willingness to walk. The key

to developing walkability is to improve walkable designs. Walkable designs refer to adding elements to the environment, such as street connectivity, so that people can easily walk in the environment. Traditional walkability elements include street connectivity, climate, safety, to name a few. The current research explores new elements – "nudges" – to provide an alternative way of thinking for walkable design. "Nudges" are tools, aiming at making people behave in a way out of their willingness and enthusiasm. Previous studies gathered up nine robust nudges that have been repeatedly found to induce behaviors powerfully, including messenger, norms, ego, incentives, salience, default, commitment, priming, and affect. The present study focused on three of them, namely, norms, salience, and priming. Corresponding to each nudges, three questions are proposed:

1. **Can norms nudge us to walk?**

2. **Can priming nudge us to walk?**

3. **Can salience bias nudge us to walk?**

Briefly, norms are typical patterns of behavior, generally accompanied by the expectation that people will behave according to the pattern. The norm in this study delivered the information that most tourists are walking, expecting a tourist who received the information will act consistently with the majority. Priming is a phenomenon whereby exposure to one stimulus influences a response to a subsequent stimulus, without conscious guidance or intention. The present study primed tourists with walking shoes in advance, expecting they have higher intention in walking in later experiments. salience bias predisposes individuals to focus on items that are more prominent or emotionally striking and ignore those that are unremarkable. In order to generate salience bias, sidewalks of a street view on a black-and-white sketch were highlighted with colors. Then, the study displays the sketch with colored sidewalks to tourists, expecting those with salience bias have a higher intention to walk. The second chapter further discusses norms, priming, and salience. The concepts and

elements of “nudge” and “walkability” will also be further interpreted in the following chapter.

2. LITERATURE REVIEW

2.1 Walkability

2.1.1 Concept

At the outset, urban planning widely used the concept of walkability (Shelton, 2008). Back in the last century, Cervero and Kockelman (1997) discussed the importance of walkability for cities. He proposed 3d's layout, namely "density", "diversity", and "design", as to dimensions of designing a walkable city. After that, the discussion on dimensions of walkability has begun to gather momentum, such as R. Ewing et al. (2013) expanded 3d's to a 5d's by adding "destination accessibility" and "distance to transit". Further, studies suggested that safety, convenience, and attractiveness be incorporated into walkability components (Krambeck, 2006). Recently, studies proposed 7C's consisting of "connected", "convenient", "comfortable", "convivial", "conspicuous", "coexistence" and "commitment" (Brebbia & Ricci, 2017; Moura, Cambra, & Gonçalves, 2017). Up to date, it is widely accepted that key concerns for a walkable city are diversity, density, and connectivity (de Cambra, 2012).

Nonetheless, as an accepted term, "walkability" is rarely defined in dictionaries (Forsyth, 2015). Hall and Ram (2019) stated walkability is the extent to which the built environment promotes walking. In other words, walkability is a measure of how friendly the environment is to walking. Evidence for such conclusion are that walking were consistently found related to environment (Heath et al., 2006; Board, 2005; Saelens, Sallis, & Frank, 2003). Studies suggested motivators for walking come from

multiple aspects of it (C. Lee & Moudon, 2004; Humpel, Owen, & Leslie, 2002; Owen et al., 2004; Saelens & Handy, 2008; Y. Wang, Chau, Ng, & Leung, 2016). Some major characteristics are convenient public transport (Hoehner, Ramirez, Elliott, Handy, & Brownson, 2005), comfortable natural sceneries (Organization et al., 1995), esthetics of the surroundings (Inoue et al., 2010; Shigematsu et al., 2009; Van Dyck et al., 2013), proper trail surface (Brownson et al., 2000), and well-maintained neighborhoods (Hoehner et al., 2005).

An earlier study has found that safety was associated with walking for exercise (Hovell et al., 1989). Later studies showed that sidewalk connectivity (Cervero & Duncan, 2003; Moudon, Hess, Snyder, & Stanilov, 1997; Saelens et al., 2003) and proximity to neighborhood businesses (S. Handy, 1996; S. L. Handy & Clifton, 2001) are robust predictors of walking trips. Furthermore, the quality of the pedestrian environment, including the presence of street lighting, benches, landscaping, and trees, was cited as a determinant of walking behavior (Forsyth, Hearst, Oakes, & Schmitz, 2008). In the same vein, Ball, Bauman, Leslie, and Owen (2001) found an aesthetically pleasing environment (e.g., ratings of pleasant and attractive natural features) is associated with an increased likelihood of walking. Additionally, environmental studies reported positive associations between access to open space and high neighborhood walkability (Humpel et al., 2002; Owen et al., 2004).

To sum up, it is still debating about which environmental characteristics have the strongest association with walking. In order to include suitable environmental factors in later experiments, the author identified five common traits mentioned in most literature: proximity, connectivity, climate, aesthetics, and safety. The following paragraphs will explain each of them in detail.

2.1.2 Elements

Proximity

Proximity consists of two aspects, density and diversity. Typically, a high density is associated with an equally high diversity (Frank & Pivo, 1994). Density is furthermore collectively referred to as "perceived density" and "measured density."

The evaluation of "perceived density" varies according to culture, countries, circumstances, and people, and thus the same density can be perceived in very different ways. (Bechtel, 2010). For instance, people from Middle Eastern perceive both a lower level of density and appreciate crowded situations more than people from North American (Pons, Laroche, & Mourali, 2006). In the same vein, the evaluation of quantifiable "measured density" is also inconstant, mainly due to the lack of an integrated model of such measures (Dovey & Pafka, 2014). Common "measured density" include dwelling density, residential density and job density (de Cambra, 2012). Residential density was found positively related to the number of minutes of moderate physical activity per day (Frank, Schmid, Sallis, Chapman, & Saelens, 2005). Similarly, B. B. Brown et al. (2009) also identified the positive relationship, and indicated residential density makes walking more appealing because driving through congested areas where parking is often scarce is repulsive.

Diversity is the extent to which a given area hosts different types of activities and functions (e.g., commerce, services, houses). Diversity measures have not reached a consensus. Three categories were identified (Brownson, Hoehner, Day, Forsyth, & Sallis, 2009), namely perceived measures based on self-administered questionnaires (Pikora, Giles-Corti, Bull, Jamrozik, & Donovan, 2003; Ramirez et al., 2006), archival data sets based on analysis of Geographic Information System (GIS), and observational measures based on systematic audits (Cunningham, Michael, Farquhar, & Lapidus, 2005; Emery, Crump, & Bors, 2003; Pikora et al., 2003). Owen et al. (2004)

suggested high diversity should bring great walkability, for diversity brings many walking destinations together in an area. In other words, if an area hosts a single type of activity, accessing other activities and functions implies traffic usage. On the contrary, an area that hosts diverse activities and functions can reduce the traffic usage, given that there is no need to reach areas for more services.

Connectivity

Advocates of New Urbanist and neo-traditional planning concepts regard street connectivity as a critical component for neighborhood design (Dill, 2004). Connectivity characterizes the ease of moving between origins and destinations within the pedestrian pattern. It is about whether streets are pedestrian-friendly networked that create fairly clear and direct routes between origins and destination (B. B. Brown et al., 2009).

Measures of connectivity include the number of blocks or the number of intersections per unit of area. Specifically, with more blocks and intersections, the city could provide many alternative routes and enable walkers to vary their routes for variety, safety, and convenience (Holtzclaw, 1994). Standard instruments to measure connectivity include Link-Node Ratio (R. Ewing, 2020) and Pedsheds (Porta & Renne, 2005; Commission et al., 2007), while what levels of connectivity are appropriate are still being hotly debated.

It is worth noting that numerous studies indicated a correlation between grid-like street patterns and walking trips (Cervero & Duncan, 2003; Dill, 2004; S. Handy, Cao, & Mokhtarian, 2006; Moudon et al., 1997; Saelens et al., 2003). For example, Dill (2004) claimed more grid-like street networks are preferred over networks that include many cul-de-sacs and long blocks. In the same vein, Moudon et al. (1997) found that walking was more frequent in neighborhoods with direct pathways and grid-pattern layouts, according to a comparison among twelve communities.

Safety

Safety is regarded as the basic requirement for walkability (Lorenc et al., 2012) and should go first beyond other factors (Forsyth, 2015). However, studies also suggested that people do present hierarchies of needs for walking, but safety typically is not placed at the most basic level (Alfonzo, 2005; Mehta, 2008; Stones, 2010). Variables to be included in safety measurement seem to reach a consensus. Global Walkability Index suggested the component of safety should consist of crossing safety, quality of motorist behavior, and perception of security from crime (Krambeck, 2006).

Specifically, earlier studies suggested low traffic volumes are crucial to building a walkable environment (Rahaman, 2010). Then, protection for pedestrians, such as buffers, signalized crosswalks, and traffic calming, were recognized (R. H. Ewing, 1999). More recent studies (Forsyth, 2015; Gorrini & Bertini, 2018) distinguished perceived safety from actual safety. Gorrini and Bertini (2018) stated streets should be designed to guarantee the safety of people while walking and crossing by installing surveillance and lighting systems that convey the tourists a sense of security. Correspondingly, Forsyth (2015) pointed out that perceived traffic safety was key elements to walkability. Note that perceptions of safety vary greatly, especially with factors of gender and social class (Lorenc et al., 2012). Furthermore, the perception of security from crime catches some attention. If the crime is the lens, Forsyth (2015) suggested, the focus should be with entrapment spots, free signs of disarray and people perceived as threatening.

Aesthetics

Environmental aesthetics significantly contribute to outdoor physical activity (Ball et al., 2001; Humpel et al., 2002). Hoyle, Hitchmough, and Jorgensen (2017) claimed the interesting, charming, and authentic nature of the plants along the street are significant correlates of walking for exercising. More comprehensively, Kirillova, Fu,

Lehto, and Cai (2014) identified nine aspects to measure aesthetic qualities, specifically from the tourists' perspective.

Uniqueness, Novelty, and Shape

"Uniqueness" suggests that tourist aesthetic judgment depends on whether the destination possesses uniquely identifiable features, such as a well-known landmark of a place, whereas "novelty" exemplifies the contrast between a familiar and a new environment. Kirillova and Lehto (2015) suggested novel destinations tend to be perceived as more beautiful than familiar landscapes. "Shape" of aesthetic quality refers to an atypical environment that provides tourists with an unusual experience. It is primarily about the contrast to standard dimensions such as roundness and symmetry.

Balance, Diversity, and Sound

"Balance" demonstrates harmony (Galindo & Hidalgo, 2005) and compatibility (Kaplan, Kaplan, & Brown, 1989). It relates to the suitability of visual cues to the overall cohesiveness of the destination. Apart from being complied with each other, when these visual cues are diverse, "diversity" of the destination occurs. Differently, "sound" represents auditory cues. It contains the pace, the source, and the volume of the sound.

Scale, Condition, and Time

"Scale" of a place refers to perceived dimensions, such as the intensity of colors, physical proportions, and degree of crowdedness. Likewise, "condition" depicts the perceived hygienic conditions of a destination where the environment is free of litter, homeless people, stray animals, and poor air quality. Last but not least, "time" includes modern and historical attributes of a place where the degree of being fashionable or authentic is seen as an essential criterion for aesthetic quality.

Climate

Earlier research believed that higher temperatures (up until certain heat-thresholds) were positively associated with observed outdoor place attendances (Brandenburg & Arnberger, 2001; J. F. Dwyer, 1988; Cervero & Duncan, 2003; Thorsson, Lindqvist, & Lindqvist, 2004; Zacharias, Stathopoulos, & Wu, 2001, 2004). Afterwards, studies further revealed sunlight and precipitation had significant associations with outdoor place attendances (Lin, 2009; Nikolopoulou & Lykoudis, 2007; Thorsson, Honjo, Lindberg, Eliasson, & Lim, 2007), whereas wind has relatively less affects (Aultman-Hall, Lane, & Lambert, 2009; Böcker, Dijst, & Prillwitz, 2013; Burke, Sipe, Evans, & Mellifont, 2006).

Air temperature, precipitation, and sunlight were also found having impressive correlations with the volumes of pedestrians (Aultman-Hall et al., 2009; de Montigny, Ling, & Zacharias, 2012; Thorsson et al., 2007), de Montigny et al. (2012) reported that 14% increase in pedestrian was associated with 5 Celsius increase in temperature, a shift from snow to dry conditions contributed to 23% increase in pedestrians, and 5% increment in sunlight gained another 2% pedestrians.

It is noteworthy that either in earlier or more recent research, studies have concluded 1) tourism demand is significantly related to the destination climate, and 2) destination climate, including temperature, sunlight, and precipitation, is a major determinant of vacation activity choice (Arbel & Ravid, 1985; Eymann & Ronning, 1997; Goh, Law, & Mok, 2008; Li, Song, & Li, 2017; Lohmann & Kaim, 1999).

2.2 Nudging

2.2.1 Concept

Theories in social psychology, cognitive psychology, and neuroscience have supported the idea that our behavior is the result of both conscious and non-conscious processes in our brain (J. A. Bargh & Ferguson, 2000; Evans & Frankish, 2009; Heatherton & Wagner, 2011; Wood, Labrecque, Lin, & Rünger, 2014; Strack & Deutsch, 2004; Wood & Neal, 2007). The conscious response is the result of the cognitive system, also known as "system 2". System 2 processes information by a reflective, controlled, rule-based, slow, conscious, and rational way (Evans, 2008). Differently, the unconscious response is the result of the automatic system, or called "system 1". System 1 processes information by an intuitive, uncontrolled, effortless, fast, and unconscious way (Evans, 2008). This dual systems model (Chaiken & Trope, 1999) laid the foundations for further conjectures that our brain is working in different ways.

Behavioral sciences increasingly agree that contexts significantly influence our behavior, because contexts lead system 1 to play a decisive role in determining our behavioral outcomes (DellaVigna, 2009; Poundstone, 2010). Along the line, Thaler and Sunstein (2009) coined a term, choice architecture, to conclude the situation. According to Thaler and Sunstein (2009) and several related studies (Baldwin, 2014; Balz, Sunstein, & Thaler, 2014; E. J. Johnson et al., 2012), choice architecture is regarded as the environment, framing and steering the final choice of the decision-maker. Nudge techniques express choice architecture concretely. Specifically, a nudge is any particular aspect of the choice architecture. It alters people's behavior predictably through the impact of the context. Note that nudges are not mandates and never forbid any options (Thaler & Sunstein, 2009). For example, putting the fruit at eye level counts as a nudge, but banning junk food does not.

2.2.2 Robust nudges

"Nudges" refer to a variety of easy and cheap changes made to the choice environment (Thaler & Sunstein, 2009). The changes successfully create more opportunities for the desired choice, such as the healthy choice, by appealing to decision-makers' heuristic cues and biases in a decision making context (Van Kleef & van Trijp, 2018). In this way, nudge has been widely used in health care plans, including diet (Volpp et al., 2008; Oster, 2018), exercise (Carrera, Royer, Stehr, & Sydnor, 2018), medical-testing decisions (Oster, Shoulson, & Dorsey, 2013), and addiction (Gruber & Köszegi, 2001), to name a few. Dolan et al. (2012) gathered up nine robust techniques that have been repeatedly found to nudge behaviors powerfully. The following paragraphs explained each technique in detail.

Messenger, Norms, and Salience

"Messenger" refers to the source of the message. Classical works (Doob & Gross, 1968; Hofling, Brotzman, Dalrymple, Graves, & Pierce, 1966) have shown that the messengers' authority can generate receivers' automatic reactions. For example, nurses will likely unthinkingly comply with doctors' instructions, even if doctors are wrong (Hofling et al., 1966). Differently, "norms" focus on the content of the message. It suggests we are strongly influenced by what others do (Dolan et al., 2012). For instance, the norm that most people wear seat belts increased the number of passengers using seat belts (Linkenbach & Perkins, 2003).

"Salience" attends to the way of presenting a message. It indicates that our behavior is greatly influenced by what our attention is drawn to (Kahneman & Thaler, 2006), such as putting healthy food at eye level reduces the consumption of unhealthy food (Levy, Riis, Sonnenberg, Barraclough, & Thorndike, 2012; Wilson, Buckley, Buckley, & Bogomolova, 2016). It is worth noting that our attention is much more likely to be attracted to the things that we can easily "encode." In other words, the

most critical element for drawing attention is the simplicity for understanding (Dolan et al., 2012; Houser, Reiley, Urbancic, et al., 2008).

Incentives and Ego

People respond to "incentives" (Dolan et al., 2012). Paying people to change their behavior is one example. Earlier research has shown that incentives help to achieve healthier lifestyles, including eating healthier foods (Marteau, Ashcroft, & Oliver, 2009), taking more exercise (Paul-Ebhohimhen & Avenell, 2008), and drinking fewer alcohol (Lu & Ma, 2006). However, the use of extrinsic incentives was found no significant effect on long-term behavior maintenance(Marteau et al., 2009; Paul-Ebhohimhen & Avenell, 2008). By contrast, "ego" provides more intrinsic motivations. One example could be advertising that points out that smoking causes yellow teeth reduced smoking behavior (Gibbons, Gerrard, Blanton, & Russell, 1998; Gibbons, Gerrard, Lane, Mahler, & Kulik, 2005). It works due to our inner desire for a positive self-image. People are effortless willing to change the demand to conform with a positive self-image (Hogg & Abrams, 1990; Tesser, 1986).

Default and Priming

Human beings tend to go with the flow of pre-set options largely because of an aversion to change (Halpern, Ubel, & Asch, 2007). Based on this concept, a "default" is an option that will come into force if no active choice is made (Dolan et al., 2012), such as setting HIV as part of routine care unless people specifically choose not to be tested (Branson et al., 2006). Defaults exert its effect through hyperbolic discounting (O'Donoghue & Rabin, 1999), loss aversion (Tversky & Kahneman, 1991) and presumed suggestions that imply a recommended action (E. J. Johnson & Goldstein, 2003).

"Priming" implies sub-conscious cues often influence our acts (Dolan et al., 2012). Specifically, prior exposure to situation cues alters later behavior (J. A. Bargh, 2006;

J. A. Bargh & Chartrand, 1999; L. E. Williams & Bargh, 2008). For example, displaying running shoes primes a healthy lifestyle and encourages people to exercise more (Wryobeck & Chen, 2003), and placement of stairs inspire people to take near stairs instead of taking elevators nearby (Blumenthal-Barby & Burroughs, 2012; Mengisen, 2008). Upon the nature of the task, priming cues could be divided as perceptual/attention, motor/action, or semantic priming (LaBerge & Buchsbaum, 1990; Strack & Deutsch, 2004). Note that which priming techniques have a more significant effect on our behavior is less understood (Dolan et al., 2012).

Affect and Commitment

"Affect" refers to emotional response. Emotional response to words and images is rapid and automatic so that people use emotional evaluations as the basis of decisions before their cognitive assessment (system 2) takes place (Kahneman, 2003a, 2003b; Slovic, Finucane, Peters, & MacGregor, 2007). Consequently, affect is regarded as a dominant force in decision-making, from trivial decisions to serious ones. For example, buying houses is not only because of floor size or location but because of the visceral feeling the buyers get when walking through the front door (Dijksterhuis, Bos, Nordgren, & Van Baaren, 2006; Zajonc, 1980). In the case of trivial decisions like washing hands, messages evoking the emotion of disgust improved hand-washing and soap use in public restrooms immediately (Curtis, Garbrah-Aidoo, & Scott, 2007; Judah et al., 2009).

The connotation of "commitment" is that people seek to be consistent with their public promises and reciprocate acts (Dolan et al., 2012). It reflects the adherence of a person's pledge or obligation towards continued task involvement. In improving healthy lifestyles, commitment is recognized as a psychological determinant of conducting exercise behavior (Corbin, Nielsen, Borsdorf, Laurie, et al., 1987; Martin & Hausenblas, 1998). For example, compared with those without assigned obligation,

participants who signed a contract of walking steps are much more likely to achieve their exercise goals (B. R. Williams, Bezner, Chesbro, & Leavitt, 2005)

As discussed above, nudge has been widely used in health plans and is valuable in health improvement. To improve walkability design, we suggest nudging techniques to be worth a shot. Previous studies of walkability seldom incorporate nudge tools. The present study is the first to attempt such an idea and applied three nudge tools. Each of the tools will be discussed further in the following paragraphs.

2.2.3 Priming

Priming is a technique whereby exposure to one stimulus can in turn affect behavior in similar situations without conscious guidance (E. K. Papies & Aarts, 2016; E. Papies & Barsalou, 2015; J. Bargh & Chartrand, 2000; Weingarten et al., 2016). The mechanism results from our cognitive structures where memory could be triggered by preceding environmental cues (Foerde, 2010; J. A. Bargh & Ferguson, 2000). In the study of human memory, our memory systems have been well described as consisting of explicit and implicit forms of memory (Graf & Schacter, 1985; Schacter, 1987). Explicit memory refers to conscious recollection of prior experiences. Differently, in implicit memory, the remembrance of previous experiences is never intentional or deliberate. The distinction between explicit and implicit memory is similar to differences between memory with awareness vs. memory without awareness (Jacoby & Witherspoon, 1982), declarative memory vs. non-declarative memory (Squire, 1992), and direct memory vs. indirect memory(M. K. Johnson & Hasher, 1987). Along the line, priming is a form of implicit memory. It occurs independently of any conscious or explicit recollection of previous experiences (Schacter, 1992). The prior experiences further provide environmental cues, influencing perceptions and behaviors in subsequent similar situations (Janiszewski & Wyer Jr, 2014).

A priming technique generally involves either semantic priming or associative priming (Plaut, 1995). Semantic priming refers to using words that are associated logically or linguistically (de Lima Müller & de Salles, 2013), such as priming consumers with names of prestige brands before leads to the choice of expensive products in later tasks (Chartrand, Huber, Shiv, & Tanner, 2008). Differently, associative priming indicates the appearance of one idea can remind the subject of another relative notion, such as seeing sneakers hours before inspires exercisers to think of running later (Haggard, 2008). It should be pointed out that priming cues from the environment can also affect behavior by triggering goals (E. K. Papies, 2016). For example, subliminal exposure to fast-food symbols can prime time-saving purposes, thus lead to preferences for time-saving actions (Zhong & DeVoe, 2010). In the same vein, runner's magazines prime the goal of exercise and consequently increases workout behaviors (Wryobeck & Chen, 2003).

Priming is increasingly used in the study of health-related behaviors (Chartrand et al., 2008; E. K. Papies, 2016; E. K. Papies & Hamstra, 2010; E. K. Papies, Potjes, Keesman, Schwinghammer, & Van Koningsbruggen, 2014; Gaillet, Sulmont-Rossé, Issanchou, Chabanet, & Chambaron, 2013; Iso-Ahola, 2017). However, concerning walking behavior, empirical research has been limited to date (Rebar et al., 2016; St Quinton, 2017). As a preliminary attempt, the present study explores whether people will walk instead of taking motor vehicles, by priming sneakers in advance.

H1: Compared with priming nothing, priming people with sneakers is more likely to nudge them to walk.

2.2.4 Salience

Over the last three decades, psychologists and behavioral economists have documented a large number of ways in which individual judgments and choices depart

from optimal decision making and information processing(Gilovich, Griffin, & Kahneman, 2002; Kahneman & Tversky, 2013; Bettman, 1979). Most of the departures, often called biases, are due to a limited capacity for concurrently processing all information relevant to the decision problem (Van De Laar, Heskes, & Gielen, 1997), including memories about previous experiences, attributes of the choice stimuli, and the probabilities of potential gains and losses. As a consequence, perceptual salience plays a crucial role in biasing attention when multiple items are present (Itti & Koch, 2001; Itti, Koch, & Niebur, 1998).

Perceptual salience is the degree to which exogenous features (e.g., contrasting colors, visual brightness) contrast with their surroundings (Itti & Koch, 2001; Itti et al., 1998). It succeeds in capturing observers' attention, regardless of their intentions (Theeuwes, 1992). In a recent study, Milosavljevic, Navalpakkam, Koch, and Rangel (2012) presented observers with two food items and asked them to choose their preferred one. They manipulated the perceptual salience of one of the choices by increasing its brightness and changing its colors, and found that perceptual salience was an even more reliable predictor than food preference in participants' final decisions. It is noteworthy that cognitive loads, such as talking on a cellphone while shopping and attending to a child that came along for the shopping trip, can further induce visual salience biases (Milosavljevic et al., 2012). Drolet, Luce, and Simonson (2009) suggested when purchasing a bag of chips in a grocery store, consumers' engagement in multiple cognitive-demanding tasks increases the importance of externally available information in their final purchase choice, especially the color of the package.

Color is prominent in obtaining attention, creating emotional responses, and producing autonomic biological reactions (Bellizzi, Crowley, & Hasty, 1983; Cheng, Wu, & Yen, 2009; Ettis, 2017). Further, studies divided the effects of color into cool and warm colors, considering the impact of warm color and cool color on physiological and psychological functioning is not alike (Elliot, Maier, Moller, Friedman, & Meinhardt, 2007). In general, "warm" colors have been found prompting an outward focus and

producing forceful action, whereas "cool" colors were posited to encourage an inward focus and to produce calm and stable action (Bellizzi & Hite, 1992; Elliot et al., 2007; K. Goldstein, 1942). Specifically, physiologically, warm colors were found increasing blood pressure, respiratory rate, and eyeblink frequency (Gerard, 1958), escalating hand tremor and speed of movement (Nakshian, 1964), enhancing grip strength and physical strength (K. Goldstein, 1942; Green et al., 1982), and improving reaction speed (Elliot & Aarts, 2011). Psychologically, warm colors have strong excitation potential and high arousal qualities (Bellizzi et al., 1983; Schaie & Heiss, 1964). They are emotionally arousing (Bellizzi & Hite, 1992), and associated with exciting themes, such as boldness, adventurousness, advancement, and vitality (Aaronson, 1970; Osgood, 1971; Rahmatabadi, Teimouri, & Azar, 2011). On the contrary, cool colors have an adverse effect (Bellizzi & Hite, 1992). They are identified with peaceful, calm and restful states (Sharpe, 1974; Burris-Meyer, 1935), an inner and contractive orientation (K. Goldstein, 1939), reserved personality (Rickers-Ovsiankina, 1943), concentration (Bjerstedt, 1960), and efficient performance in activities requiring judgement and precision (Nakshian, 1964). Note that red is the hottest of the warm colors, whereas blue is the coldest cool color. They are near the opposite end of the color spectrum from each other (Bellizzi et al., 1983). Moreover, warm colors have more visibility than cold colors (Danger et al., 1987). Among warm colors, red and yellow are the best eye-catchers, both having a high degree of visibility (J. V. White, 1990).

In a nutshell, perceptual salience influences our decision-making process by biasing attention (Itti & Koch, 2001; Theeuwes, 1992). Colors play a key role in perceptual salience and capturing attention (Ettis, 2017; Milosavljevic et al., 2012). Further, distinct from cool colors, warm colors are physically stimulating and emotionally arousing (Bellizzi & Hite, 1992; Elliot et al., 2007), and more salient than cool colors (Danger et al., 1987; J. V. White, 1990). Therefore, we hypothesized that whether people choose to walk depends on the visibility of sidewalks, and the visibility of sidewalks correlates with the color of them. Hypotheses were illustrated as follows:

H2: Compared with uncolored sidewalks, colored sidewalks are more likely to nudge people to walk.

H3: Compared with blue-colored sidewalks, red-colored sidewalks are more likely to nudge people to walk.

2.2.5 Descriptive Norms

The social norms effect is one of the nine most robust effects on nudging behavior (Dolan et al., 2012). Social norms include two types — prescriptive norms and descriptive norms. Prescriptive norms refer to moral values and societal standards about behaviors (Cialdini, Reno, & Kallgren, 1990; Reno, Cialdini, & Kallgren, 1993). Descriptive norms refer to what most people do in the situation (behavioral frequency) (Burger et al., 2010), and provide a standard of the majority from which people do not want to deviate (Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007). Research has shown that descriptive norms are likely to nudge individuals departing from the norm to conform to typical peer behavior (Chang, Huh, & Lee, 2016; Nolan, Schultz, Cialdini, Goldstein, & Griskevicius, 2008).

Further, Cialdini and Goldstein (2004) indicated that several factors are known to influence the extent to which individuals will adhere to the descriptive norms of a given reference group. One crucial factor is the level of perceived similarity among others and a given individual (Burnkrant & Cousineau, 1975; Moschis, 1976). According to the social comparison theory (Festinger, 1954), people often evaluate themselves by comparing themselves to others, especially to those with whom they share similar characteristics. In line with this supposition, early evidence showed people indeed intend to follow the behavior of those who share similar features, including age (J. Murray & Oster, 1984), gender (K. M. White, Hogg, & Terry, 2002), attitudes (Carli, Ganley, & Pierce-Otay, 1991) and personality attributes (Suedfeld, Bochner,

& Matas, 1971). Correspondingly, psychologists further found the group identification to be a robust effect, changing how we act and see the world (Hewstone, Rubin, & Willis, 2002).

Based on the above discussion, we assume descriptive norms can encourage people to walk, and descriptive norms with group-identification information even have a more positive effect. Thus, the hypotheses were proposed as follows:

H4: Compared with presenting nothing, presenting descriptive norms is more likely to nudge people to walk.

H5: Compared with presenting traditional descriptive norms, presenting descriptive norms that contain group identification information is more likely to nudge people to walk.

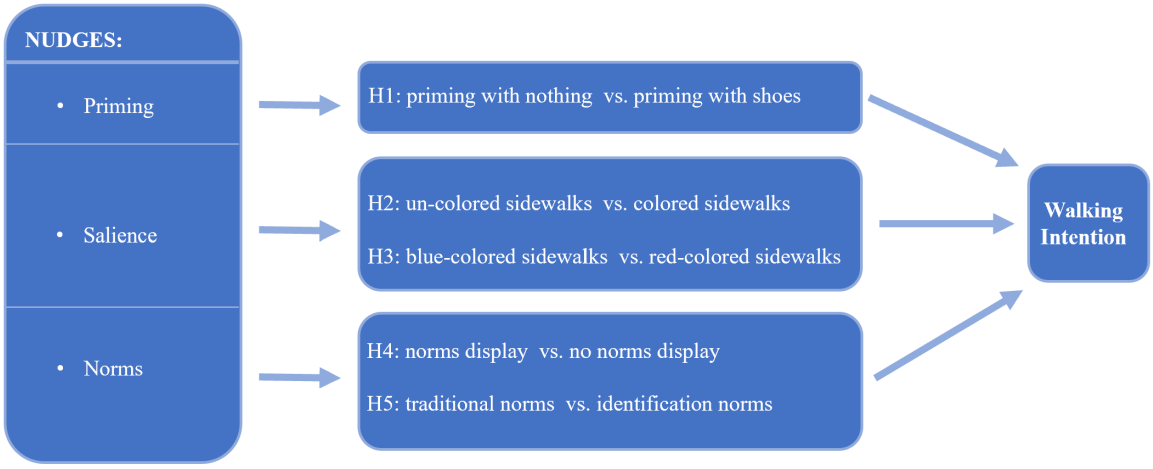

Figure 2.1 Framework and Hypotheses

3. METHODOLOGY

3.1 Design of Experiments

3.1.1 Factorial Design

Factorial experiments focus on the effect of two or more factors on a measured purpose (Milton & Arnold, 1995). Such an experiment allows the investigator to study the effect of each factor on the response variable, as well as the effects of interactions between or among the factors on the response variable. In a three-factor factorial design, only three factors are involved, say factors A, B, and C. Considering there are **a** levels of factor **A**, **b** levels of factor **B**, and c levels of factor **C**, $a \times b \times c$ is the total number of treatment combinations (cells). A treatment combination (cell) is a level of factor A applied in conjunction with a level of factor B and C. The type of statistical analysis employed in factorial design is the analysis of variance (ANOVA).

The study adopted a between-subject method, with a 2x3x3 full factorial experimental design for three factors: priming, salience, and descriptive norms. Collectively, eighteen different questionnaires were assigned to each of the 18 groups (see Figure 3.1). The present study employed a factorial design for three main reasons (Montgomery, 2017): First, factorial designs are more efficient than one-factor-at-a-time experiments. Second, factorial designs help to avoid misleading conclusions biased by factor interactions. Third, factorial designs yield valid results over a range of experimental conditions, for the effects of one factor are allowed to be estimated at several levels of the other factors.

Priming / Norms / Salience	Primed			Unprimed		
	Identification norm	Traditional norm	No norm	Identification norm	Traditional norm	No norm
Red-colored sidewalks	x	x	x	x	x	x
Blue-colored sidewalks	x	x	x	x	x	x
Un-colored sidewalks	x	x	x	x	x	x

Figure 3.1 A 2x3x3 Factorial Design

Hypothesis 1

H1: Compared with priming nothing, priming people with sneakers is more likely to nudge them to walk.

To test **H1** that is priming inspires people to walk, priming consists of two levels — priming with sneakers and priming with nothing. The former is the treatment group, and the latter is a control group. Following the study of Iso-Ahola and Miller (2016), this study primed the experiment group with four pairs of walking shoes and asked participants to rate each pair of shoes' aesthetics at the beginning of the survey. On the contrary, the control group received no operation.

In order to mitigate the risk of shoes' preference bias, a pilot test was performed to select proper shoes with a general aesthetic. The pilot sample consists of 100 respondents and is from different age groups. These shoes are from common brands with styles for both females and males, and displayed in pictures taken from their official online stores. Finally, four pairs of shoes were decided from eight pairs of shoes. Figure 3.2 illustrates each pair of shoes.

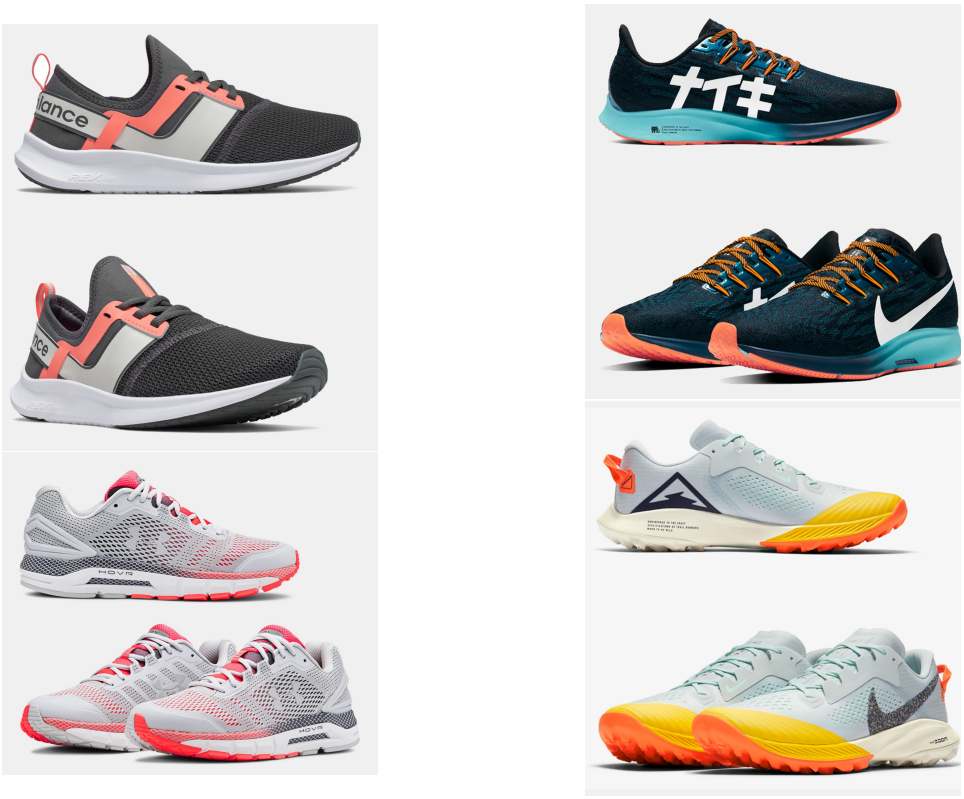

Figure 3.2 with shoes

Hypothesis 2 and Hypothesis 3

H2: Compared with uncolored sidewalks, colored sidewalks are more likely to nudge people to walk.

H3: Compared with blue-colored sidewalks, red-colored sidewalks are more likely to nudge people to walk.

The second and the third hypotheses assume colored sidewalks have a significant effect on nudging people to walk **(H2)**, especially red-colored sidewalks **(H3)**. The salience factor comprises three levels, namely un-colored sidewalks (control group), blue-colored sidewalks (treatment group 1), and red-colored sidewalks (treatment group 2). Following the study of Milosavljevic et al. (2012), to assess H2, purely

black-and-white street-view sketches (see Figure 3.3) were arranged for the control group, whereas the treatment groups looked at sketches with colored sidewalks. To confirm H3, one treatment group looked at blue-colored sidewalks (see Figure 3.4), while the other one looked at red-colored sidewalks (see Figure 3.5). Note that this study used RGB(255,0,0) and RGB(0,0,255) to form red and blue, respectively.

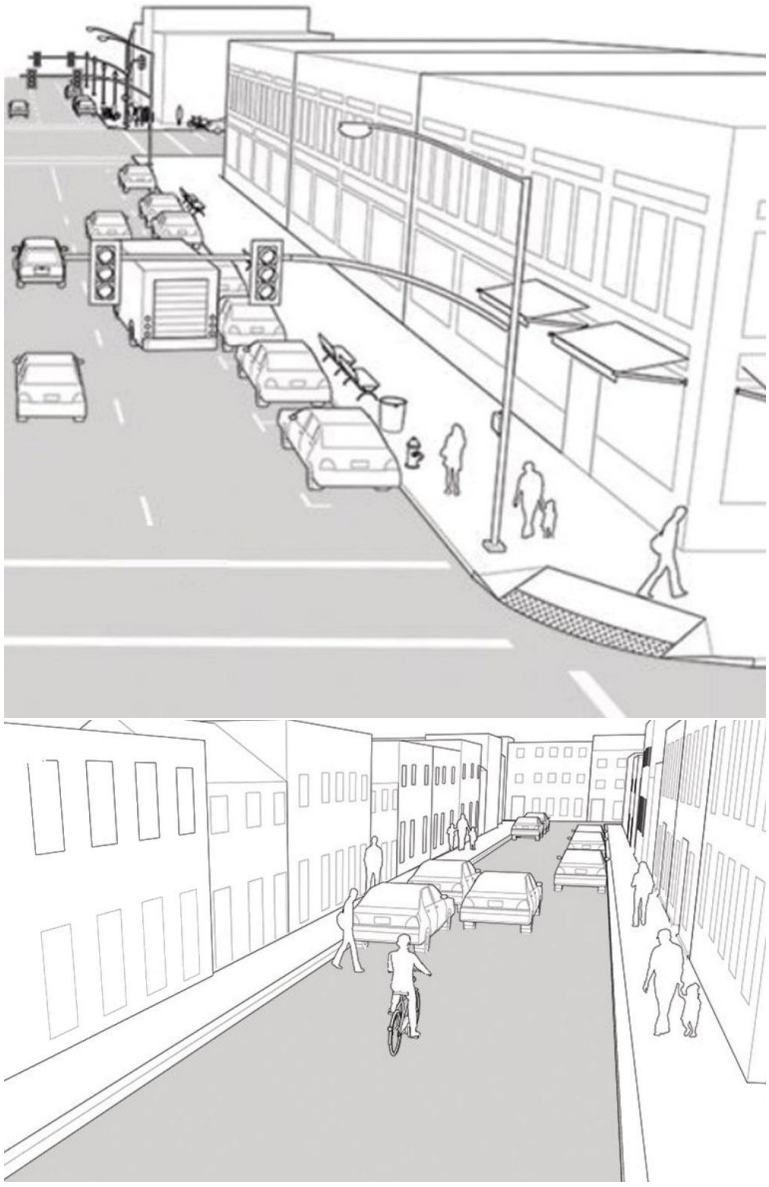

Figure 3.3 Un-colored sidewalks

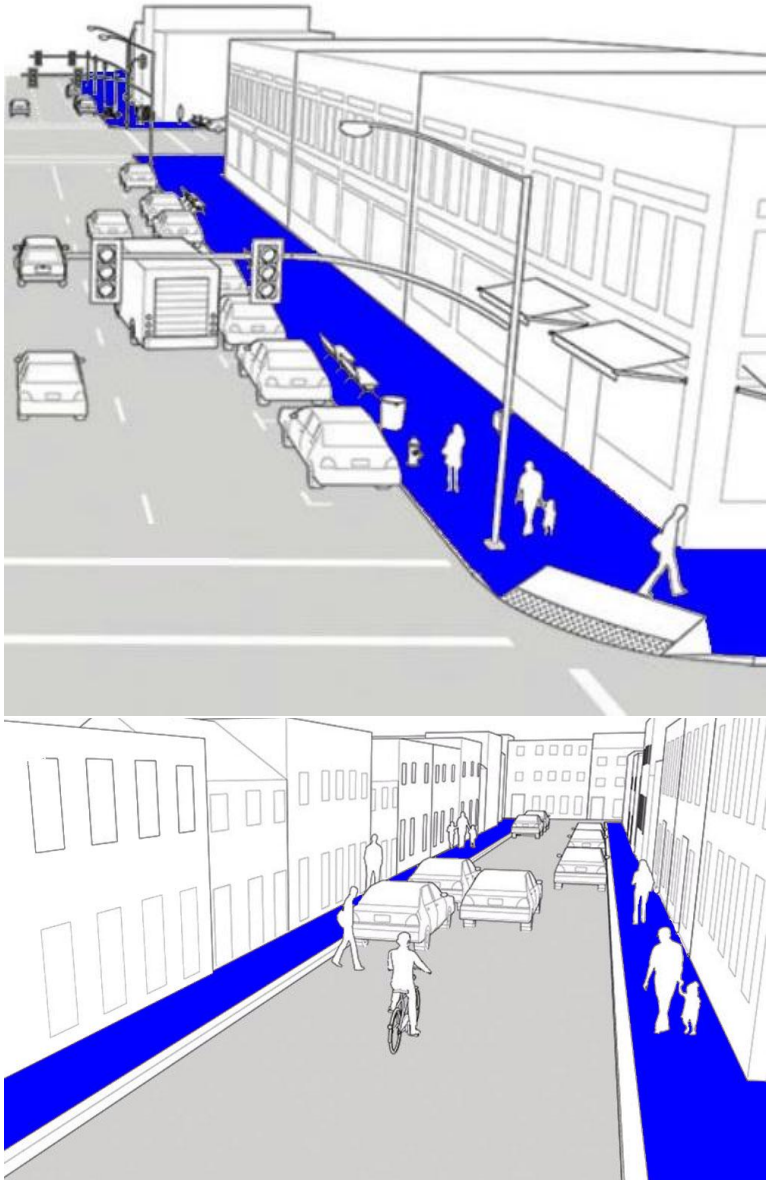

Figure 3.4 Blue-colored sidewalks

Hypothesis 4 and Hypothesis 5

H4: Compared with presenting nothing, presenting descriptive norms is more likely to nudge people to walk.

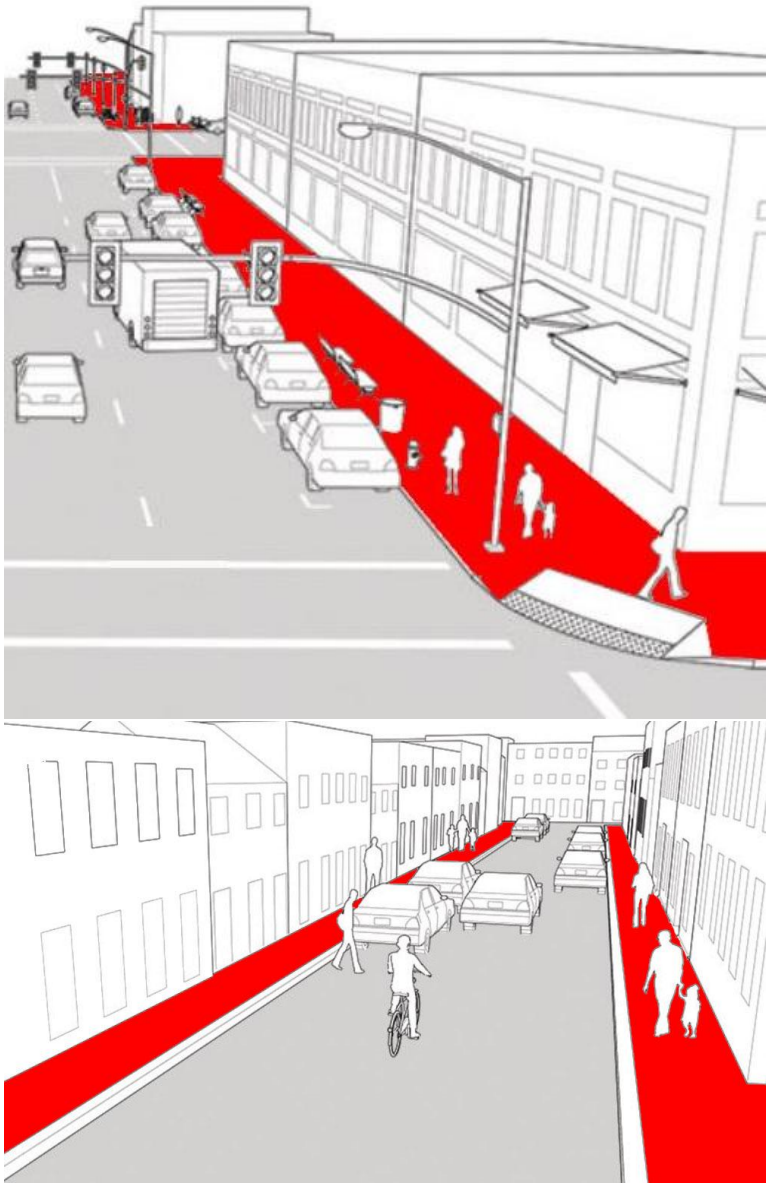

Figure 3.5 Red-colored sidewalks

H5: Compared with presenting traditional descriptive norms, presenting descriptive norms that contain group identification information is more likely to nudge people to walk.

The fourth and fifth hypotheses expect descriptive norms have potent impacts on walking intention **(H4)**, especially descriptive norms with identification information

(H5). The factor holds three levels, namely no descriptive norms (control group), traditional descriptive norms (treatment group 1), and descriptive norms with identification information (treatment group 2). In accordance with the study of N. J. Goldstein, Cialdini, and Griskevicius (2008), the traditional descriptive norm was designed to be "3 out of 4 people (75% of people) choose to walk rather than take motor traffic", and the descriptive norm with identification information was "3 out of 4 tourists (75% of tourists) who are traveling in this city choose to walk rather than take motor traffic." Appendix E reveals the information in detail.

3.1.2 The Scenario

Experiments in the study are scenario-based. As discussed in chapter 2, traditional walkability elements, such as safety, weather, and distance, play crucial roles in influencing people's walking intentions. Therefore, the traditional walkability elements are included as control variables in the scenario. Consequently, a participant imagined being a tourist. He/she is traveling in a safe, tranquil, and clean city with grid-like street networks. A picture of grid-like street networks followed the description to make participants have a better understanding of the street pattern (see Figure 3.6).

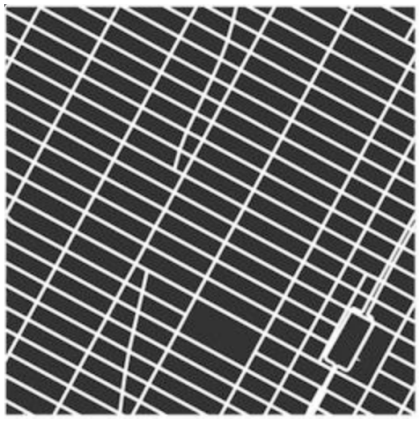

Figure 3.6 **Grid-like street networks**

Meantime, the participant understood that the city is moderately populated, and the tourist attraction is 2 miles away. The reason for using 2 miles as the distance is that both the Centers for Disease Control and Prevention (CDC) and American Heart Association recommend taking walks with a minimum 30-minute duration per day (*Walking: Your steps to health - Harvard Health*, n.d.), and people walk 30 to 40 minutes for 2 miles on average. Moreover, participants additionally learned it is a day with no wind, no rain, decent sunlight, and modest temperature. Appendix C demonstrates the full scenario information.

3.1.3 The Procedure

First, half of the participants get into the aforesaid scenario directly. While the rest participants are primed with shoes and asked to rate aesthetics, then they get into the scenario. After imagining to be tourists, participants were told that — before leaving their guest room, they look out the windows and see the street views like the picture shows. One-third of the participants are displayed with the uncolored sidewalks picture; one-third of them are displayed with blue-colored sidewalks picture; the rest one-third of participants are displayed with the red-colored sidewalks picture. Next, after seeing one of the pictures. Again, one-third of the participants are given the traditional descriptive norm; one-third of them are given the group-identity descriptive norm. In comparison, the rest one-third of participants are not given any norms and asked to rate their walking intentions immediately. All participants rated their walking intention with a 7 point Likert scale.

Walking intention was measured with a 7 point Likert scale. The theory of reasoned action (TRA) identifies intentions as the determinate predictor of performing a behavior (Ajzen & Fishbein, 1969; Fishbein & Ajzen, 1977). Meanwhile, intentions were proved quite useful in understanding exercise intentions. Riddle (1980) showed that jogging behavior was highly correlated with intentions to jog. In the same vein,

intention toward exercise was found having a direct influence on exercise behavior (Bentler & Speckart, 1981). Therefore, the present study used walking intention as the response variable to predict people's walking behavior. Adapted from the study of (Sieverding, Decker, & Zimmermann, 2010), the present investigation measured walking intention with a 7-point scale. By answering the question "Do you intend to walk to the tourist attraction?", participants give their walking intention score from "definitely not (1)" to "definitely yes (7)".

3.1.4 Additional Variables

To have a more comprehensive understanding of how walking intentions are formed, more variables were included in the questionnaire.

Firstly, aiming at understanding how colored sidewalks influence people's walking intention, the study added three more questions referring to enjoyment, excitement, and visibility. Based on the color psychology theory that red color is exciting and warm color brings pleasant emotions, participants were asked to rate their feelings about walking to the tourist attraction on the colored sidewalk. The endpoints of (1) unenjoyable - enjoyable and (2) boring - exciting were used to evaluate: "I think walking to the tourist attraction would be." Moreover, participants were also asked to rate the visibility of the sidewalks. The perceived visibility of sidewalks was measure by (3) having participants agree or disagree with the proposition: "I think the sidewalks are easy to be noticed." A seven-point Likert scale was used for each of the three questions. The three questions help to find out why colored sidewalks and how colored sidewalks can nudge people to walk.

Second, questions about participants' exercise habits were included in the questionnaire, for it might deliver valuable insights to interpret the results. Following the study of Ouellette, Hessling, Gibbons, Reis-Bergan, and Gerrard (2005), the present

study asked participants' three questions regarding their exercise behavior: "How many times a week do you engage in non-sport aerobic exercise (e.g., walking, stationary cycling)?" "How many times a week do you take part in sports that include aerobic exercise (e.g., basketball and soccer)?" and "How many times a week do you engage in aerobic exercise for at least 30 minutes?". Each question was followed by an 8-point scale from 0 (never) to 7 (7 or more times a week). Responses of the three questions were averaged and then used to measure the respondent's exercise behavior.

Additionally, respondents' were asked to rate the aesthetics of the scenery displayed in sidewalk scratches. This is due to aesthetics was found having particular importance in encouraging people to walk, and people prefer to walk in places they perceive as aesthetically attractive (Ding, Sallis, Kerr, Lee, & Rosenberg, 2011; Moudon et al., 2006; Nasar, Holloman, & Abdulkarim, 2015). By answering the question that " comparing to the street views of those cities where you once traveled in real life, how attractive do you think the above street views are? ", participants give their perceived aesthetics score from "extremely unattractive (1)" to "extremely attractive (7)".

3.2 Data Collection

The study chose a self-administered online questionnaire as the method to collect primary data for several reasons (Birks & Malhotra, 2006). First, an online questionnaire is identified with a high speed of distribution. Second, the self-administered questionnaire ensures anonymity and leads to a high response rate. Third, with the integration of logic and validity checks, the online tool is optimal for high data quality. Despite the online questionnaire's advantages, we should beware of its limitations. Firstly, access to the Internet is a prerequisite to the completion of the questionnaire. It somehow leads to a convenience sample in that people who are not connected to the Internet or do not feel comfortable using it are excluded from the study. The

second drawback is potential technical issues. To alleviate this risk, the questionnaire has been implemented using Qualtrics, a reliable online survey tool with high user-friendliness.

Data were collected in a two-week period from April 14^{th} to April 30^{th} 2020. With IRB approval, data were collected through Amazon's Mechanical Turk (Mturk). Mturk is a commercial platform where researchers can create work for others to participate via the web. Social scientists frequently use this service for research purposes as it provides streamlined access to a diverse and reliable example (Buhrmester, Kwang, & Gosling, 2011). Finally, a total of 1,800 participants were recruited voluntarily via Mturk.

3.3 Data Analysis

The study used SPSS (IBM Corp., n.d.) to perform data analyses. Descriptive statistics were used for the study sample's demographic characteristics. Note that the researcher used an alpha value of .05 for all conclusions, to limit the probability of committing the type I error to 5%, as a standard in social sciences (Newey & McFadden, 1994). Only Surveys that are 100% completed are used for all analyses.

First of all, five Mann-Whitney U tests were used to assess each hypothesis. The Mann-Whitney U test (Mann & Whitney, 1947) is the non-parametric equivalent of the Student t test. It is used for comparing two levels of the independent variable with between-group designs (Morgan, Leech, Gloeckner, & Barrett, 2010), and is suitable for ordinal scales such as the Likert Scale (Pallant, 2013). Similar to a t-test, the null hypothesis for a Mann-Whitney U test is that the treatment effects on two populations are equal versus, while the alternate hypothesis assumes the effects on two populations are not equal (Hollander, Wolfe, & Chicken, 2013).

$$H_0 : \tau_1 = \tau_2 \tag{3.1}$$

To implement a Mann-Whitney U test, four primary assumptions should be met: 1) the dependent variable should be measured on an ordinal scale or a continuous scale, 2) the independent variable should be two independent, categorical groups, 3) observations should be independent, and 4) observations should follow the same distribution shape, such as both are skewed left. Note that researchers have to be aware of an increased likelihood of a Type II error, implying a higher chance of accepting that there is no difference between groups while there is a difference in reality (Field & Hole, 2002).

Secondly, a Kruskal-Wallis H test, the non-parametric equivalent of the one-way analysis of variance (ANOVA), was performed to compare the difference of walking intentions among the eighteen groups. The Kruskal-Wallis H test, or Kruskal-Wallis one-way analysis of variance (KW-ANOVA), is an extension of the Mann-Whitney U test (Kruskal et al., 1952). Applying it can test hypotheses concerning multiple independent samples.

$$H_0 : \tau_1 = ... = \tau_k \tag{3.2}$$

A finding of significant differences in the KW-ANOVA result indicates that at least two of the data samples are significantly different. Determining which samples are significantly different can be done with a *post-hoc* pairwise comparison between each pair of data. The SPSS generally carries out a Dunn's *post-hoc* to test each pair of groups (Marshall, n.d.).

The Mann-whitney U test and Kruskal-Wallis H test primarily aim at examining the hypotheses and checking whether priming, norms, and salience have significant

effects on walking intention. Further, the author conducted a regression analysis to check how these effects work on participants' walking intentions.

A three-way ANOVA was adopted to tentatively inspect the explained variances of walking intention from the three factors: priming, norms, and salience. Moreover, visibility, enjoyment, and excitement are tested as mediators that bridge salience and walking intentions through simple and multiple linear regressions. Finally, the author applied a multiple linear regression to present a walking intention equation with five variables: norms, priming, visibility, enjoyment, and excitement. The following chapter further demonstrated the application of each method.

4. RESULTS

A total of 1,800 questionnaires were collected from participants via Amazon's Mechanical Turk (Mturk). The data were screened for non-valid responses in several steps. First, the author looked at validity items to identify mindless responses and deleted respondents who answered these questions incorrectly. Second, due to Purdue's Institutional Review Board requirements, responses by participants under 18 years old age were eliminated. Third, the author excluded responses with an absolute standardize value higher than 3. This procedure is efficient in removing statistical outliers that may bias regression-based analyses (DiLalla & Dollinger, 2006). Finally, only 1,503 responses that were 100% completed remained for further analysis.

4.1 Demographics of the Sample

Table 4.1 demonstrates the demographic information, including gender, age, health status, exercise behavior, education, employment status, income, and working industry. Of the 1,503 respondents, 41.72% were females, and 58.28% were males. The ages of respondents were 34.97 on average. The largest category of respondents was the bachelor degree group (55.36%), followed by the master's degree group (22.95%) and the high-school-diploma group (16.03%). Respondents reported employment in a variety of industries (11 types). The most common reported sectors were education services (14.04%), business services (12.18%), and health services (10.58%). Exercise behavior was described by exercising times per week, ranging from none to seven and more times. Exercising three times a week was reported by the largest proportion of

survey participants (20.09%). Never engaging in any exercise (2.46%) and exercising seven or more times a week (3.46%) were reported by the smallest proportion of respondents. Among the 1,503 respondents, nearly half of them (42.71%) considered their health very good.

Table 4.1 Demographic profile of respondents (N= 1503)

Variables	**Categories**	**N**	**Percent**
Gender			
	Female	627	41.72%
	Male	876	58.28%
Age			
	18-29	652	43.38%
	30-39	480	31.94%
	40-49	209	13.91%
	50-59	93	6.19%
	≥60	69	4.59%
Exercise Behavior			
	Never	37	2.46%
	Once a week	160	10.65%
	Twice a week	253	16.83%
	3 times a week	302	20.09%
	4 times a week	275	18.30%
	5 times a week	262	17.43%
	6 times a week	162	10.78%
	7 or more rimes a week	52	3.46%
Health Status			
	Excellent	339	22.55%
	Very good	642	42.71%
	Good	444	29.54%
	Fair	72	4.79%
	Poor	6	0.40%
Education			
	Hight School	241	16.03%
	Bachlor's Degree	832	55.36%
	Master's Degree	345	22.95%
	Ph.D.	40	2.66%
	Others	45	2.99%
Employment			
	Employed	903	60.08%
	Self employed	252	16.77%
	Unemplyed and seeking work	127	8.45%

Table 4.1 continued

	Looking after family family / not seeking work	32	2.13%
	Retired	33	2.20%
	In full time education	136	9.05%
	Other	20	1.33%
Annual Household Income (USD)			
	Less than $10,000	227	15.10%
	$10,000 - $19,999	176	11.71%
	$20,000 - $29,999	164	10.91%
	$30,000 - $39,999	171	11.38%
	$40,000 - $49,999	122	8.12%
	$50,000 - $59,999	145	9.65%
	$60,000 - $69,999	94	6.25%
	$70,000 - $79,999	87	5.79%
	$80,000 - $89,999	66	4.39%
	$90,000 - $99,999	60	3.99%
	$100,000 - $149,999	132	8.78%
	$150,000 - $199,999	39	2.59%
	Over $200,000	20	1.33%
Working Industry			
	Health services	159	10.58%
	Education services	211	14.04%
	Wholesale and retail trade	83	5.52%
	Professional and business services	183	12.18%
	Manufacturing	119	7.92%
	Leisure and hospitality	54	3.59%
	Construction	57	3.79%
	Financial services	122	8.12%
	Transportation and utilities	38	2.53%
	Public administration	39	2.59%
	Information	148	9.85%
	Other	290	19.29%

4.2 Results of Hypotheses

Appropriate statistical tests must be selected to examine the hypotheses. At first glance, independent t-tests seem to be the intuitive choices with the comparing means of two different groups – the control group and the treatment group. However, the

independent t-test is constrained by normal distribution assumption (Field & Hole, 2002). According to the Shapiro-Wilk test of which the null hypothesis is that the variables are normally distributed, outcome measures of control groups and treatment groups failed to meet the normality assumption. In other words, the normality assumption for independent t-test was violated.

Alternatively, the study selected the Mann-Whitney U test, a non-parametric equivalent of the independent t-test, as the primary statistical tool. As discussed in chapter 3, the Mann-Whitney U test is the non-parametric test employed with ordinal data in a hypothesis testing that involves design with two independent samples. It is likely to be more potent than the t-test "when the dependent variable for two independent groups is either ordinal or continuous, but not normally distributed" (Berenson et al., 2015). However, the non-parametric tests have a higher risk of not showing significant differences where they actually exist in that they are less sensitive to the normality of the data.

4.2.1 Mann-Whitney U Test

Priming: Hypothesis 1

H1: Compared with priming nothing, priming people with sneakers is more likely to nudge them to walk.

According to Table 4.2, the Mann-Whitney U test reveals significant differences between the walking intention of the primed group (mean rank=782.40, n=769) and the un-primed group (mean rank=720.15, n=734) with p=0.002. Therefore, H1 is supported. This result suggests that priming sneakers positively affect people's the walking intention, indicating that if tourists see advertisements for sneakers while

traveling, they would probably choose walking as their subsequent transportation mode.

Table 4.2 Mann-Whitney U Test
(Priming: Primed versus Un-primed)

Priming groups	**N**	**Mean Rank of Walking Intention**	**Sum of Ranks**
Primed	769	782.40	601664.50
Unprimed	734	720.15	528591.50
Total	1503		

Test Statistics	
Mann-Whitney U	258846.500
Asymp. Sig. (2-tailed)	0.002

Salience: Hypothesis 2 and 3

H2: Compared with uncolored sidewalks, colored sidewalks are more likely to nudge people to walk.

Looking at Table 4.3, the Mann-Whitney U test reveals significant differences between the colored-sidewalk group (mean rank=779.13, n=1012) and the uncolored-sidewalk group (mean rank=696.09, n=491) with P=0.000. Thus, H2 is supported, indicating that conspicuous sidewalks raise tourists' the walking intention. In other words, to nudge people to walk, urban designers are suggested to make the sidewalks stand out in its surroundings.

Table 4.3 Mann-Whitney U Test
(Salience: Colored Sidewalks versus Uncolored Sidewalks)

Colors of Sidewalks	**N**	**Mean Rank of Walking Intention**	**Sum of Ranks**
Colored Sidewalks	1012	779.13	788474.50
Uncolored Sidewalks	491	696.09	341781.50
Total	1503		

Test Statistics	
Mann-Whitney U	220995.000
Asymp. Sig. (2-tailed)	0.000

H3: Compared with blue-colored sidewalks, red-colored sidewalks are more likely to nudge people to walk.

The Mann-Whitney U test (Table 4.4) reveals significant differences between the red-colored sidewalk condition (mean rank=526.25, n=519) and the blue-colored sidewalk condition (mean rank=485.71, n=493) with p=0.016. H3 is supported. This means that blue sidewalks and red sidewalks have different effects on people's the walking intention, and red sidewalks are more likely to increase people's intention to walk. The result also suggests that cool colors are not as effective as warm colors in inspiring people to walk. Warm colored sidewalks are more likely to nudge people to walk.

Table 4.4 Mann-Whitney U Test
(Salience: Red-colored Sidewalks versus Blue-colored Sidewalks)

Colors of Sidewalks	**N**	**Mean Rank of Walking Intention**	**Sum of Ranks**
Red-colored Sidewalks	519	526.25	273122.00
Blue-colored Sidewalks	493	485.71	239456.00
Total	1012		

Test Statistics	
Mann-Whitney U	117685.000
Asymp. Sig. (2-tailed)	0.016

Norms: Hypothesis 4 and 5

H4: Compared with presenting nothing, presenting descriptive norms is more likely to nudge people to walk.

The Mann-Whitney U test (Table 4.5) reveals significant differences between the norm-display group (mean rank=776.48, n=1031) and the no-norm display group (mean rank=698.52, n=472) with P=0.000. H4 is supported, suggesting that descriptive norms play a role in nudging people to walk. Specifically, tourists are more likely to choose to walk when they realize that most people are walking.

Table 4.5 Mann-Whitney U Test
(Descriptive Norms: Norms Display versus No Norms Display)

Norms	**N**	**Mean Rank of Walking Intention**	**Sum of Ranks**
Norms Display	1031	776.48	800556.00
No Norms Display	472	698.52	329700.00
Total	1503		

Test Statistics	
Mann-Whitney U	218072.000
Asymp. Sig. (2-tailed)	0.000

H5: Compared with presenting traditional descriptive norms, presenting descriptive norms that contain group identification information is more likely to nudge people to walk.

As reported by Table 4.6, descriptive norms with identification information shows a significantly higher mean (mean rank=533.28, n=505) than traditional descriptive norms (mean rank=499.41, n=526) with p=0.044. H5 is supported, indicating that the identification descriptive norm is more effective than the traditional descriptive norm in increasing tourist's walking intention. Specifically, tourists are more likely to walk when they realize that most of their fellow travelers are walking.

Table 4.6 Mann-Whitney U Test
(Descriptive Norms: Identification Norms versus Traditional Norms)

Norms	**N**	**Mean Rank of Walking Intention**	**Sum of Ranks**
Identification Norms	505	533.28	269305.00
Traditional Norms	526	499.41	262691.00
Total	1031		

Test Statistics	
Mann-Whitney U	124090.000
Asymp. Sig. (2-tailed)	0.044

4.2.2 Kruskal-Wallis H Test

At first sight, a one-way analysis of variance is advisable to compare the means of eighteen groups. Nonetheless, three basic assumptions need to be fulfilled for performing a one-way ANOVA (Fleiss, Levin, & Paik, 2013), namely: (a) normality — dependent variable should be approximately normally distributed, (b) independence of observations — the observations must be independent, (c) homogeneity of variances: variances across each group should be equal. Levene's test (M. B. Brown & Forsythe, 1974) tested homogeneity of variance (equal variances), and the null hypothesis failed to be rejected (p=.066), indicating the assumption of homogeneity was met. However, according to the Shapiro-Wilk test, the normality assumption was not satisfied with $p < 0.05$ (Shapiro & Wilk, 1965). Alternatively, the Kruskal-Wallis H test was adopted as a non-parametric equivalent of the one-way analysis of variance (one-way ANOVA) (Noether, 2012).

Table 4.7 reveals significant differences among all 18 groups with the p-value less than .05, demonstrating the detailed descriptive statistics of mean ranks for each factor level combination. The highest the walking intention belong to the group primed with walking shoes, displayed with red-colored sidewalks and traditional descriptive norms. As expected, groups without any treatments get the lowest walking intention, again proving the decisive role of nudging techniques in leading people to walk. A post-hoc Dunn's Bonferroni test identified eight significantly different pairs (see Table 4.8). It indicates significant contrasts in the walking intention between the groups with three treatments combined and the groups without any treatments. Overall, the Kruskal-Wallis H test once again proved the forceful roles of priming, salience, and norms in effecting tourists' walking intention.

Table 4.7 Kruskal-Wallis H Test of Factor Level Combinations

Descriptive Statistics of Mean Ranks (N)	Primed			Unprimed		
	Identification norm	Traditional norm	No norm display	Identification norm	Traditional norm	No norm display
Red-colored sidewalks	875.63 (n=99)	**905.85** (n=101)	807.8 (n=71)	832.74 (n=73)	726.66 (n=95)	675.75 (n=80)
Blue-colored sidewalks	796.04 (n=84)	677.71 (n=78)	783.71 (n=90)	760.58 (n=84)	770.97 (n=72)	698.82 (n=85)
Un-colored sidewalks	773.82 (n=80)	740.58 (n=92)	619.35 (n=74)	760.61 (n=85)	667.48 (n=88)	**590.57** (n=72)

Test Statistics	
Kruskal-Wallis H	63.053
df	17
Asymp. Sig.	0.000

Table 4.8 Pairwise Comparisons of Factor Level Combinations [a]

Sample 1 - Sample 2 [c]	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[b]
N-I	315.282	61.261	5.147	0.000	0.000
E-I	-286.500	60.776	-4.714	0.000	0.000
N-G	285.057	61.518	4.634	0.000	0.001
E-G	-256.275	61.035	-4.199	0.000	0.004
O-I	238.369	57.918	4.116	0.000	0.006
Q-I	230.101	59.446	3.871	0.000	0.017
C-I	-228.146	59.870	-3.811	0.000	0.021
N-P	-242.170	65.970	-3.671	0.000	0.037
O-G	208.143	58.190	3.577	0.000	0.053
K-I	207.034	58.462	3.541	0.000	0.061
Q-G	199.876	59.711	3.347	0.001	0.125
C-G	-197.921	60.132	-3.291	0.001	0.153
N-H	217.233	66.429	3.270	0.001	0.164
E-P	-213.388	65.519	-3.257	0.001	0.172
N-A	205.472	63.789	3.221	0.001	0.195
R-I	179.194	56.767	3.157	0.002	0.244
N-B	193.136	62.800	3.075	0.002	0.322
K-G	176.809	58.731	3.010	0.003	0.399
F-I	-165.275	57.242	-2.887	0.004	0.594
E-H	-188.451	65.982	-2.856	0.004	0.656
N-D	183.249	64.521	2.840	0.005	0.690
E-A	176.690	63.323	2.790	0.005	0.806
N-L	180.403	66.197	2.725	0.006	0.983

a. Appendix G shows entire data of pairwise comparisons
b. Significance values have been adjusted by the Bonferroni correction for multiple tests.
c. Each letter represents a combination factor levels. Alphabetical interpretation is as follows.

Alphabetical interpretation:

A: Primed/BlueColored/IdentificationNorm
B: Primed/BlueColored/NoNorm
C: Primed/BlueColored/TraditionalNorm
D: Primed/UnColored/IdentificationNorm
E: Primed/UnColored/NoNorm
F: Primed/UnColored/TraditionalNorm
G: Primed/RedColored/IdentificationNorm
H: Primed/RedColored/NoNorm
I: Primed/RedColored/TraditionalNorm
J: Unprimed/BlueColored/IdentificationNorm
K: Unprimed/BlueColored/NoNorm
L: Unprimed/BlueColored/TraditionalNorm
M: Unprimed/UnColored/IdentificationNorm
N: Unprimed/UnColored/NoNorm
O: Unprimed/UnColored/TraditionalNorm
P: Unprimed/RedColored/IdentificationNorm
Q: Unprimed/RedColored/NoNorm
R: Unprimed/RedColored/TraditionalNorm

4.3 Results of Multivariate Analysis

4.3.1 Regression: Three Nudges and Walking Intention

A three-way ANOVA was added to inspect the effect size brought by each factor and the total variances of walking intention explained by the three factors. According to Table 4.9, priming, salience, and descriptive norms are all significant for predicting the walking intention with p values less than 0.05. Additionally, no interaction was founded between or among priming, salience, and descriptive norms, indicating that the nudging effects of one factor on the walking intention are independent of the value and level of another two factors.

The partial eta squared (η_p^2) is an efficient way to compare the effects sizes of different between-subjects factors in the same design (Keppel, 1991). In the present study, priming, salience, and descriptive norms explain 1% ($\eta_p^2 = .01$) , 1.4% ($\eta_p^2 = .014$), and 1.5% ($\eta_p^2 = .015$) of total variance for the walking intention respectively. The total variance accounted for by the three factors is 4% (adjusted R-squared = .04). The explained variance for the walking intention is small, suggesting factors more than priming, salience, and descriptive norms should be included in further research.

4.3.2 Regression: Mediators of Salience

As described in the methodology, three questions about visibility, enjoyment, and excitement were added to understand how salient sidewalks influence the walking intention. The author firstly adopted three Kruskal-Walls tests to have a sight in whether participants have different feelings (enjoyment and excitement) and different perceived visibility toward separate colored sidewalks.

Table 4.9 Effect Size of Prime, Salience and Descriptive norm

Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared η_p^2**
Corrected Model	42.222	17	2.484	4.635	0.000	0.050
Intercept	58230.998	1	58230.998	108682.735	0.000	0.987
Desctiptive norm	12.184	2	6.092	11.370	0.000	0.015
Prime	8.102	1	8.102	15.122	0.000	0.010
Salience	11.104	2	5.552	10.362	0.000	0.014
Norm * Prime	1.150	2	0.575	1.073	0.342	0.001
Norm * Salience	4.306	4	1.077	2.009	0.091	0.005
Prime * Salience	2.446	2	1.223	2.283	0.102	0.003
Norm * Prime * Salience	2.256	4	0.564	1.052	0.379	0.003
Error	795.646	1485	0.536			
Total	59915.000	1503				
Corrected Total	837.868	1502				

R Squared = .050 (Adjusted R Squared = .040)

According to Table 4.10, red-colored sidewalks did not become more exciting than blue-colored sidewalks, but participants indeed viewed walking as more exciting when the sidewalks are colored. According to Table 4.11, sidewalks with a warm color (i.e.red) did not be regarded as more enjoyable to walk on, compared with sidewalks with a cool color (i.e., blue). However, participants indeed consider colored sidewalks as more enjoyable to walk on than un-colored sidewalks. According to Table 4.12, participants considered colored sidewalks as more visible than un-colored sidewalks, which is within expectations. The three Kruskal-Walls tests reveal a close relationship between colored sidewalks against invisibility, excitement, and enjoyment. Consequently, the author conducted a mediation analysis to identify the mechanism that underlies the relationship between colored sidewalks and the walking intention via the inclusion of visibility, enjoyment, and excitement.

Table 4.10 Kruskal-Wallis H Test of Colored Sidewalks - Excitement

Boring-Exciting of Walking on Colored Sidewalks

Kruskal-Wallis Test Summary	
Total N	1503
Test Statistic	23.762
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	0.000

Pairwise Comparisons

Sample 1 - Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
UnColored - RedColored	-74.711	26.514	-2.818	0.005	0.015
UnColored - BlueColored	-130.428	26.852	-4.857	0.000	0.000
RedColored - BlueColored	55.717	26.486	2.104	0.035	0.106

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Table 4.11 Kruskal-Wallis H Test of Colored Sidewalks - Enjoyment

Unenjoyable-Enjoyable Measurement of Walking on Colored Sidewalks

Kruskal-Wallis Test Summary	
Total N	1503
Test Statistic	11.397
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	0.003

Pairwise Comparisons

Sample 1 - Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
UnColored - RedColored	-69.538	25.357	-2.742	0.006	0.018
UnColored - BlueColored	-79.297	25.680	-3.088	0.002	0.006
RedColored - BlueColored	9.759	25.330	0.385	0.700	1.000

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Table 4.12 Kruskal-Wallis H Test of Colored Sidewalks - Visibility

Perceived Visibility Measurement of Colored Sidewalks

Kruskal-Wallis Test Summary	
Total N	1503
Test Statistic	73.584
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	0.000

Pairwise Comparisons

Sample 1 - Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
UnColored - BlueColored	-159.525	25.121	-6.350	0.000	0.000
UnColored - RedColored	-203.197	24.806	-8.192	0.000	0.000
BlueColored - RedColored	-43.672	24.780	-1.762	0.078	0.234

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

A mediation analysis includes three steps (Baron & Kenny, 1986): 1) confirming the independent variable is a significant predictor of the dependent variable by regressing the dependent variable on the independent variable, 2) confirming the independent variable is a significant predictor of the mediators by regressing mediators on the independent variable, and 3) confirming the previously significant independent variable is greatly reduced or even become non-significant when mediator are added.

The first step of the mediation analysis has been completed by the earlier regression (see Table 4.9), where salience was attested to a significant factor in predicting the walking intention. The author needs to accomplish another two steps. In other words, the author needs to regress visibility, enjoyment, and excitement on salience (see Table 4.13), so as to confirm the color of sidewalks is a significant predictor of the three mediators. Moreover, the author also needs to incorporate both the previously significant independent variable (e.i. salience factor in the first walking equation) and the mediators (e.i. visibility, enjoyment, excitement) into the walking intention equation. If the significance level of the previously significant independent variable (the salience factor) is significantly reduced, mediators (visibility, enjoyment, excitement) can replace the previous independent variable and play as new predictors in predicting the walking intention.

Table 4.13 Mediators Confirmation

Regression Analysis:
Whether salience is a significant predictor of the three mediators: visibility, enjoyment, excitement

Coefficients (dependent variable: visibility)

Model	Coef	Coef Std. Error	T-value	P-value (Sig.)
Constant	6.147	0.031	200.685	0.000
Salience (colored sidewalks)	0.198	0.023	8.467	0.000

Coefficients (dependent variable: enjoyment)

Model	Coef	Coef Std. Error	T-value	P-value (Sig.)
Constant	6.097	0.038	159.184	0.000
Salience (colored sidewalks)	0.088	0.029	3.001	0.003

Coefficients (dependent variable: excitement)

Model	Coef	Coef Std. Error	T-value	P-value (Sig.)
Constant	5.296	0.056	94.192	0.000
Salience (colored sidewalks)	0.108	0.043	2.502	0.012

To accomplish the step of confirming whether salience is a significant predictor of the three mediators, three simple linear regressions were adopted, respectively. Table 4.13 reveals that when salience becomes the independent variable to predict perceived visibility, the p-value for the salience factor is less than 0.05, indicating salience is a significant predictor for visibility. Similarly, p-values for enjoyment (p=0.003) and excitement (p=0.012) are both significantly small, indicating enjoyment and excitement are qualified mediators. The second step of mediation analysis is thereby achieved, confirming that the color of sidewalks is a significant predictor of the three mediators.

Next, the author applied a multiple linear regression to check whether the significance level of salience is reduced when the regression includes both the salience factor and the three mediators. According to Table 4.14, the salience factor is reduced to non-significant with a p-value equal to 0.111. It reconfirms that the prediction of the walking intention from the salience factor can be bridged well by the three mediators. The last step of mediation analysis is achieved.

Table 4.14 Mediators Re-confirmation

Regression Analysis
Whether the significane level of salience is reduced by three mediators: visibility, enjoyment, excitement

Model Summary

R	R-sq	Adj. R-sq
0.577	0.332	0.330

Analysis of Vriance

Model	Sum of Squares	df	Mean Square	F	P-value (Sig.)
Regression	278.554	6	46.426	124.175	0.000
Residual	559.314	1496	0.374		
Total	837.868	1502			

Coefficients

Model	Coef	Coef Std. Error	T-value	P-value (Sig.)	VIF
(Constant)	2.551	0.152	16.780	0.000	
Salience	0.031	0.020	1.596	0.111	1.049
Enjoyment	0.352	0.018	19.478	0.000	1.146
Excitement	0.038	0.012	3.148	0.002	1.075
Visibility	0.185	0.023	8.189	0.000	1.188
Norm	0.069	0.020	3.484	0.001	1.012
Prime	0.114	0.032	3.586	0.000	1.010

4.3.3 Regression Equation of the Walking Intention

Visibility, excitement, and enjoyment were attested to be mediators that bridge salience and the walking intention. Evidently, three new predictors (visibility, enjoyment, excitement) are qualified to replace the salience factor and be included in the new regression with two previous factors (norm and prime). Finally, a multiple linear regression with a total of five predictors is formed.

According to Table 4.15, several important points should be noticed. First, from the Analysis of Variance, the model per se is significant, indicating a significant relationship between the walking intention and all predictors (i.e., visibility, enjoyment, excitement, norm, and prime). Second, from the Coefficients sub-table, visibility, enjoyment, excitement, norm, and prime are all crucial in predicting the walking intention, with the p-value of each coefficient being less than 0.05. Third, practical experience indicates that if any of the VIF (the variance inflation factor) exceeds 5

Table 4.15 Linear Regression of Walking Intention

Regression Analysis
Regression Model of Walking Intention

Model Summary

R	R-sq	Adj. R-sq
0.576	0.331	0.329

Analysis of Vriance

Model	Sum of Squares	df	Mean Square	F	P-value (Sig.)
Regression	277.602	5	55.520	148.347	0.000
Residual	560.266	1497	0.374		
Total	837.868	1502			

Coefficients

Model	Coef	Coef Std. Error	T-value	P-value (Sig.)	VIF
(Constant)	2.535	0.152	16.702	0.000	
Enjoyment	0.353	0.018	19.481	0.000	1.146
Excitement	0.038	0.012	3.173	0.002	1.075
Visibility	0.192	0.022	8.664	0.000	1.143
Norm	0.068	0.020	3.476	0.001	1.012
Prime	0.115	0.032	3.621	0.000	1.010

Regression Equation

the walking intention = 2.535 + 0.192*Visibility + 0.353*Enjoyment + 0.038*Excitement + 0.068*Norm + 0.115*Prime

or 10, it is an indication that the associated regression coefficients are poorly estimated because of multi-collinearity (Montgomery, Peck, & Vining, 2012). From the coefficients table, VIF for each item is around 1, indicating no multi-collinearity is identified and coefficients for all predictors are convincing. Forth, the adjusted R-squared value is 0.329, revealing that the five predictors in total can explain 32.9% of the walking intention variance.

The regression equation is presented as: the walking intention = 2.535 + 0.192*Visibility + 0.353*Enjoyment + 0.038*Excitement + 0.068*Norm + 0.115*Prime. To interpret the equation, note that: 1) 7-score Likert scales measured visibility, enjoyment, excitement, and walking intention, with score 1 representing the extremely negative end and score 7 representing the extremely positive end, 2) norm factor that consists of three levels of was coded into 0, 1, and 2, where 0 presents no norm display,

1 presents traditional norm display, and 2 presents identity norm display, 3) prime that consists two levels was coded into 0 and 1, where 0 presents un-primed and 1 presents primed with shoes. Thus, when visibility, enjoyment, and excitement are endowed with the largest value 7, and norm and prime are endowed respectively with 2 and 1, the walking intention will get its highest value close to 7.

4.4 Significant Relationship: Demographics and Walking Intention

Manna-Whitney U test and Kruskal-Wallis H test were further performed to determine any significant relationships between gender, age, income, education, employment, working industry, exercise behavior, health status, and perceived aesthetics of the environment against the walking intention. Finally, the relationship between gender, working industry, exercise habits, and perceived aesthetics of the environment against the walking intention were identified.

Manna-Whitney U Test, a non-parametric equivalent of the independent samples t-test, was used to test if the difference in the walking intention between females and males was significant. Table 4.16 demonstrates that the significance was established. Females expressed a higher intention to walk.

Table 4.16 The Influence of Gender on Walking Intention

Mann-Whitney U Test

Gender	**N**	**Mean Rank of Walking Intention**	**Sum of Ranks**
Male	876	732.30	641491.50
Female	627	779.53	488764.50
Total	1503		

Test Statistics	
Mann-Whitney U	257365.500
Asymp. Sig. (2-tailed)	0.023

Kruskal-Wallis H Test, a non-parametric equivalent of the one-way analysis of variance, was used to test if the difference of the walking intention among working

industries, exercise behavior, and perceived aesthetics of the environment was significant. Curiously, people working in the industry of leisure and hospitality have higher intentions in walking (Table 4.17). Table 4.18 reveals that people who exercise frequently express a higher intention to walk while traveling. Table 4.19 indicates that when the environment is perceived attractive, people tend to show a higher intention in walking.

Table 4.17 The Influence of Working Industry on Walking Intention

Kruskal-Wallis H Test

Descriptive Statistics of Mean Ranks		
Working Industry	**N**	**Mean Rank of Walking Intention**
Health services	159	765.44
Education services	211	716.99
Wholesale and retail trade	83	738.95
Professional and business services	183	819.47
Manufacturing	119	686.00
Leisure and hospitality	54	**824.54**
Construction	57	786.54
Financial services	122	683.19
Transportation and utilities	38	787.33
Public administration	39	736.82
Information	148	712.15
Other	290	784.75
Total	1503	
Test Statistics		
Kruskal-Wallis H	20.191	
df	11	
Asymp. Sig.	0.043	

Table 4.18 The Influence of Exercise Behavior on Walking Intention

Kruskal-Wallis H Test

Descriptive Statistics of Mean Ranks		
Exercise Behavior	**N**	**Mean Rank of Walking Intention**
Never	37	672.12
Once a week	160	749.03
Twice a week	253	740.38
3 times a week	302	756.39
4 times a week	275	723.07
5 times a week	262	727.02
6 times a week	162	793.99
7 or more rimes a week	52	997.12
Total	1503	
Test Statistics		
Kruskal-Wallis H	25.870	
df	7	
Asymp. Sig.	0.001	

Table 4.19 The Influence of Perceived Aesthetics of Environment on Walking Intention

Kruskal-Wallis H Test

Descriptive Statistics of Mean Ranks		
Perceived Aesthetics	N	Mean Rank of Walking Intention
1 (Extremely unattractive)	29	478.14
2	84	390.27
3	82	544.71
4	166	804.56
5	297	725.15
6	504	731.85
7 (Extremely attractive)	341	941.83
Total	1503	
Test Statistics		
Kruskal-Wallis H	189.254	
df	6	
Asymp. Sig.	0.000	

5. CONCLUSIONS

5.1 Summary of Results

The neglect of exercise eventually resulted in the loss of health and even lives. CDC recognized physical inactivity as a significant factor in premature death in 2018 (Carlson et al., 2018). In such a dire situation, the author wishes that exercise can permeate every aspect of our lives so that we can effortlessly improve public health. With this overly idealistic vision, the author associates the concept of "walkability" with "nudging." Walkability is the ability of the environment to provide people with a willingness to walk. The key to developing walkability is to add proper elements to walkable designs. Traditional walkability elements include street connectivity, climate, safety, to name a few. The current research explores new elements – "nudges" – to provide an alternative way of thinking for walkable design. "Nudges" are behavioral intervention tools, aiming at making people behave in a way out of their willingness and enthusiasm. Traditional behavioral interventions draw on the assumption that people will change behavior when they consciously realize the harms and benefits (Riekert, Ockene, & Pbert, 2013), and thereby conventional polices of resolving healthy issues such as smoking and overeating focus on providing legislation, regulation, and information (Vlaev, King, Dolan, & Darzi, 2016). However, noticing the restriction of earlier approaches, The present study turns to nudge, assuming people behave subliminally. To test the feasibility, the study proposed three questions, namely (1) Can priming nudge us to walk? (2) Can salience nudge us to walk? (3) Can descriptive norms nudge us to walk?

Research question 1 looks into whether priming people with walking shoes nudges people to walk more. The contrast between a treatment group and a control group determined the answer. Participants in the treatment group were exposed to pictures of walking shoes, whereas the control group avoided the priming technique. Results reveal that priming with walking shoes has significant effects on inspiring people to walk. Research question 2 explores if salient sidewalks nudge people to walk more. Sidewalks were either colored in red or blue, making the sidewalks salient and opposing the uncolored sidewalks. Results suggest that salient sidewalks nudge people to walk, and warm colors like red even have more potential in encouraging walking. Research question 3 investigates whether descriptive norms conveying that most people walk can nudge receivers to walk. One control group and two treatment groups were involved accordingly for no norm display, traditional norm display, and identification norm display. Analysis indicates descriptive norms have potent effects on nudging walking, especially when added with identification information.

In a nutshell, the research attested to the positive effects of three nudging techniques on walking intention. Specifically, when people learn that most people with similar characteristics are walking, they are willing to join the majority. In the same vein, when primed with items related to exercise (such as sneakers), people are more likely to choose physical rather than motorized transportation in the subsequent transportation choices. Interestingly, the sidewalk color can also influence people's willingness to walk, and especially, when the sidewalks are in warm colors, people were more likely to walk. Moreover, when three techniques were concurrently implemented, the effect becomes most powerful. Among the three nudging techniques, descriptive norms are the most effective, followed by salient sidewalks. Priming shoes implies the least effect.

Further, three mediators were identified to bridge the effect of salience on walking intention, namely visibility, excitement, and enjoyment. Visibility represents how noticeable the sidewalks are. Excitement indicates colored and un-colored sidewalks

bring expected exciting or boring experience. Enjoyment is the degree of pleasure that participants perceived when imaging to walk on the sidewalks. Collectively, visibility, excitement, enjoyment, prime, and norms together play crucial roles in nudging people to walk. Additionally, females, exercise lovers, and hospitality and leisure industry workers tend to have higher intentions in walking while traveling.

5.2 Implications and Limitations

Two innovations are noticed. First, the present study introduced the nudging concept into walkability design, which makes people realize that in addition to typical walkability characteristics of the environment, such as proximity and connectivity, simple manual techniques can also increase walking intention. Second, the thesis originally proposed using colored sidewalks to attract attention, highlighted the effect of colored sidewalks on walking intention, and added valuable insights into different effects on walking intention between warm-colored and cool-colored sidewalks.

Theoretically, the thesis adds new knowledge to answer the question that what can influence tourists' walking intentions. First, elements affecting tourists' walking intention include visibility of the sidewalks, as well as the perceived enjoyment and excitement of walking on the sidewalks. The study shows that colored sidewalks significantly contribute to visibility, enjoyment, and excitement. Specifically, if sidewalks are contrasting to the surroundings and easily noticed, tourists reveal a higher intention in walking. Moreover, if sidewalks are colored, tourists view them as more exciting and enjoyable to be walked and thereby become more intended to walk on them. The study deconstructs tourists' walking intention to some extent, giving a valuable insight into what contributes to walking intentions from the tourists' perspective. Following the three elements, future research can further investigate into why visibility, enjoyment, and excitement are important in nudging tourists to walk,

and apart from the colored sidewalks, what other sidewalk designs can improve the visibility, enjoyment, and excitement.

Second, the present study initially attempts descriptive norms in nudging people to walk. Commonly, descriptive norms are used as interventions in environmentally-friendly behavior, such as energy conservation (P. C. Dwyer, Maki, & Rothman, 2015), recycling (Matthies, Selge, & Klöckner, 2012), and sustainable consumption (Demarque, Charalambides, Hilton, & Waroquier, 2015). However, the literature of descriptive norms associated with nudging physical activities remains scarce. This study helps to fulfill the gap and contributes to the literature of norms as a robust nudge in inspiring walking. Moreover, the present study refines descriptive norms. Specifically, it adds group-identity descriptive norms as a new branch to the original descriptive norms. It indicates that we compare ourselves with the person or the group sharing similar features. Based on this logic, descriptive norms are suggested to incorporate audience characteristics so as to be more convincing. The study contributes to the refinement of descriptive norms and the literature of social comparison.

Last but not least, the study serves as a foundation for the study of tourists' walking intentions. Three nudges lay perspectives for a future deconstruction of walking intention. For example, according to the salience nudge, the study finds that visibility, excitement, and enjoyment are three elements of walking intentions. Likewise, what mediating elements can bridge the norms nudge and the prime nudge to tourists' walking intention? Nudges in this study enlighten novel perspectives to deconstruct the walking intention.

Practically, the study implies that wellness resources need to be easily noticed by the public so as to make optimal use of healthy support. In the modern world of information explosion and information overload, people tend to ignore the things that are not eye-catching. On the contrary, items that are easily noticed can reduce cognitive load and quickly grab the public's attention. Based on the study, the

bright color is a functional trial in practice in attracting attention. However, coloring wellness resources is only one approach to attracting attention. By getting rid of the cookie-cutter sidewalks, industry practitioners can also make health products into unique shapes, large volumes, or put them in prominent positions to attract attention.

Besides improving tourists' health, tourism practitioners need to realize that wellness resources can also become a pull factor of the tourist attraction and thereby bring tourism economic benefits. Take Boston's Freedom Trail as an example. The Freedom Trail is a red-brick trail and a unique collection of museums, churches, houses, burying grounds, parks, and historic markers that tell the story of the American Revolution and beyond (*Every Step Tells a Story*, 2018). The red brick route runs about four kilometers through 16 important historic sites in downtown Boston. While nudging tourists to walk the four kilometers to have a taste of the city, the red walkway has become a must-take tourist attraction and keeps bringing visitors to Boston. For one thing, it reduces cognitive load for tourists by connecting the scattered tourist attractions and playing a similar function to a tour guide map. For another, the red walkway easily attracts visitors' attention with its unique appearance and symbolic meaning of freedom. Therefore, to promote local tourism, practitioners can consider linking local tourist attractions with colored roads. However, while linking, practitioners are also required to carefully consider the most valuable tourist attractions to be connected, the negative impacts on shops that are away from the colored walkway, and whether residents living along the way agree with the practice.

Perfect research is hard to come by. Like most studies, this study has several limitations. First, restricted by time and financial concerns, the study sample was a convenience sample collected from Amazon Turk, excluding samples that do not use the platform. The second consideration is the study's artificial setting, in which respondents' responses might not reflect their real behavior in the actual action phase. Third, some factors could not be controlled for, such as color preferences. Uncon-

trolled variables might evoke habitual behavior and could potentially change the outcome of the study. In addition, the online environment was another limitation of this study. Technically speaking, field study is the best method for accessing nudging techniques. However, due to resources limitation, the present research is unable to conduct a field study. This thesis recommends future research to be done with field studies. Finally, some studies indicated a gap between intention and action, including the classical studies of condom use (Sheeran, Abraham, & Orbell, 1999) and exercise behavior (Hausenblas, Carron, & Mack, 1997). Momsen and Stoerk (2014) implied that changing intentions would account for less than one-third of the variance in behavior change. To help overcome the action-intention gap, future questionnaires are suggested to use choices as the measurement criterion of investigation, as the measurement of choice may be able to carry out a more direct measurement of real actions (Van Kleef & van Trijp, 2018).

5.3 Discussions and Future Studies

Opposed to the study results where priming people with exercise brand was found ineffective in nudging exercise (Iso-Ahola & Miller, 2016), this study adapted the previous one and primed participants with pictures of walking shoes rather than the words of exercise brands. Priming is then attested to be effective in nudging walking. One reason for the success might be that instead of applying semantic priming, this study practiced associative priming. As discussed in chapter 2, associative priming and semantic priming are two central techniques in priming. Associative priming indicates that the appearance of one idea can remind the subject of another relative idea, such as seeing sneakers hours before inspires exercisers to think of running later (Haggard, 2008). Differently, semantic priming refers to using words that are associated logically or linguistically (de Lima Müller & de Salles, 2013), such as priming consumers with names of prestige brands before leads to the choice of expensive

products in later tasks (Chartrand et al., 2008). Is associative priming better than semantic priming? What types of contexts are appropriate for the semantic priming? How about the contexts of using associative priming?

In the present study, participants get into the scenario where they imagine to be tourists. Therefore, their opinions mostly represent the opinions of tourists instead of residents. Compared with residents, tourists travel at a slower speed and are eager to explore the new environment (Vojnovic, 2006). Samarasekara, Fukahori, and Kubota (2011) also claimed that "explorability" is one essential environmental component in inspiring tourists to walk. To some extent, their ideas explain why excitement plays a crucial role in nudging tourists to walk. However, for residents who live in the place for a long time, they have to see and walk on the same colored sidewalks repeatedly. Will walking on the colored sidewalks still be an exciting thing? The answer is probably not. Is there any way to make residents feel excited to walk? As new things bring excitement but old things cannot, is it truly a long-term solution to stimulate residents to walk by presenting exciting cues? Is improving excitement inclusively for tourists? What makes tourists want to walk, and what makes residents want to walk? All these intriguing questions are awaiting further research.

Moreover, further studies need to involve more colors of the sidewalks. In this study, red was taken as the representative of warm colors. The study found that red paths play a crucial role in visibility and grab more attention than blue sidewalks. In contrast, there was no significant difference between red and blue colors in enhancing excitement and enjoyment. However, we still cannot deny the better role of warm colors in bringing more excitement and pleasure than cool colors. Apart from red, yellow is another typical warm color. Earlier studies find yellow is less arousal than red but is more associated with cheer, gaiety, and fun (Sharpe, 1974; NAz & Epps, 2004). If the sidewalk is painted yellow instead of red, would participants who see the yellow sidewalks feel more enjoyable than those seeing blue sidewalks? Would these seeing yellow sidewalks feel more intended to walk thereby? Third, are all

cool colors less suitable in encouraging people to walk than warm colors? Note that green – another typical cool color – was considering as depicting secure and healthy (D. C. Murray & Deabler, 1957). If sidewalks were painted green, would pedestrians get the health cues, and be more intended to walk? After receiving the healthy signals, will participants additionally attend in other subsequent healthy activities more than walking?

Furthermore, as two robust nudges, prime and norm are indeed found as significant predictors in nudging walking. However, the variance of walking intentions explained by the two nudges is small. Following salience, the author suggests future studies deconstruct the tourists' walking intention by bridging prime and norms through mediators. For example, by asking participants whether they think most tourists are walking to the attraction, researchers understand how their participants absorb and agree with the norms. Researchers thereby might find that participants who believe most tourists are walking were more likely to walk than those who do not believe in the norm. In this case, the degree of trust in norms better explains the effect of norms on walking intention.

Additionally, can getting involved in walking improve the tourist experience? Mansouri and Ujang (2016) found that tourist experience was strongly related to diverse street usages and activities. In the same vein, Ujang and Muslim (2014) indicated that tourists who take walking as the mode of transportation could engage more with the place and its people and thus form an intense attachment to the destinations, yields authentic experience and enhance the trip experience. At the end of the last century, Pine and Gilmore (1999) proposed the concept of the experience economy, and described it as the next economy following the agrarian economy, the industrial economy, and the most recent service economy. Unlike the service economy, where service personnel is the industry's pillar, the experience economy is oriented by personal experience, and personal experience will become the driving force of industry development. In a nutshell, standardized services will not be enough to meet

customers' needs, while the personalized experience is the trend of demand. Is walking inherently a personalized activity? Based on the degree of participants' initiative and involvement in the project, Pine and Gilmore (2011) further theorized experiences and categorized them into four realms: entertainment realm, education realm, esthetic realm, and escapist realm. If walking can improve the experience, what is the underlying mechanism of the improvement? In other words, can walking achieve a transformation among realms, such as from a lower experience realm to a more engaging experience realm? How does walking affect visitors' experience differently from the commercial style of transportation offered by tourist destinations, such as sightseeing buses offer esthetic-realm experience while walking provides entertainment-realm experience? How different modes of transportation affect the travel experience? The correlation between transportation mode and the tourist experience deserves further discussion.

Finally, back to the overarching question, how can people participate in physical activities, such as walking? We all know exercise benefits us both physically and mentally, but why do our behavior frequently deviate from our values? In sociology, our will power cannot unilaterally determine our behavior. We are constrained by the environment, also known as structural resources. Within such a constrain, human beings have to follow the path of the least resistance. In other words, to improve public health, firstly, we need to provide enough healthy resources. Lehto and Lehto (2019) suggested that the tourism and hospitality industry take responsibility for providing protective, restorative, instorative, and transformative products. Our industry needs to be responsible for preventing the loss of tourists' wellness resources by strengthening one's wellness resources (protective), providing restore resources to help visitors recover from fatigue and regain mental focus (restorative), installing creative resources to help tourists gain new perspectives and novel ways of problem-solving (instorative), and transforming life by engendering positive life changes (transformative). For instance, tourist attractions can learn from Denmark that placed a spiral

Treetop walkway in the middle of a forest one hour south of Copenhagen connected to a 148-foot-tall observation tower, to give explorers a novel bird's eye view and motivate visitors to be physically active. Providing accessible resources is the first and most essential step in health improvement. However, when resources are short, do we have other ways to reduce the resistance to pursuing health? The answer is yes, and walkability design is one of them. For example, population density is one key element for walkability. In densely populated cities, people often choose walking as a means of transportation (Cervero & Kockelman, 1997). This is not because people living in densely populated cities prefer walking, but because walking is a more desirable option. Otherwise, they are likely to get stuck in a traffic jam or have a hard time finding a parking space. Walking thereby becomes the-least-resistance path, which is in line with human nature and is also the core theme of nudges.

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APPENDICES

APPENDIX A
INTRODUCTION FOR PARTICIPANTS

Purpose of Research: The purpose of this research is finding out which designs can encourage the public to walk more, so as to improve the physical wellness of the public, especially tourists.

Procedures: You will get into a scenario where you will imagine to a tourist travelling in a city called Bustle Escape. You may see some interesting pictures and will be asked for rating your walking intention. You will be asked for some demographic information, including gender, age, exercise habits, healthy status, education, income, employment status, and working industry.

Duration of Participation: This survey has been pilot tested to determine the average time (3 minutes - 6 minutes) it takes to complete it if the respondent fully reads and answers each question. Marked deviation from this average time could result in rejection of your completed survey.

Risks: This survey has a number of questions embedded in it as validity checks. The validity checks are to ensure that you are not a robot and are in fact fully reading and answering each question. Failure to pass the validity checks may result in rejection of your survey.

Benefits: Your participation is very important to society. This research may be able to help designers in urban planning to offer more walkable pedestrians and reduce the use of motor vehicles. In addition, it may be helpful for practitioners in tourism to develop competitive advantages in their industry.

Compensation: After your work is accepted, you will be paid 0.3 dollars.

Confidentiality: The project's research records may be reviewed by departments at Purdue University responsible for regulatory and research oversight. The survey is totally anonymous and all data will be reported in aggregate form to protect participants' privacy. All the information collected will not be used for any other purposes except for the research. The research records will be stored under the researcher's Qualtrics account for about two months until the project ends. The research records will be deleted after the project ends and nothing except the thesis will be maintained. Additionally, they may not be used for any future research purposes. The results will only be disseminated during the defense in July, 2020 at Purdue University.

Voluntary Nature of Participation: Your participation in this study is voluntary. If you agree to participate, you can withdraw your participation at any time without penalty.

Contact Information: If you have questions, comments or concerns about this research project, please contact our researchers Jun Chen (Chen3054@purdue.edu) or Xinran Lehto (xinran@purdue.edu). If you have questions about your rights while taking part in the study or have concerns about the treatment of research participants, please call the Human Research Protection Program at (765) 494-5942, or email (irb@purdue.edu).

Documentation of Informed Consent: I have had the opportunity to read this consent form and have the research study explained. I have had the opportunity to ask questions about the research project and my questions have been answered. I am prepared to participate in the research project described above.

( ) Yes, I consent.

( ) No, I do not consent .

APPENDIX B
PRIMING MANIPULATION

Rating Aesthetics

Please rate the aesthetics of some walking shoes, and choose to which extent you agree with the following statements:

1.

The walking shoes above is appealing.

	-3	-2	-1	0	1	2	3	
disagree	○	○	○	○	○	○	○	agree

2.

The walking shoes above is appealing.

	-3	-2	-1	0	1	2	3	
disagree	○	○	○	○	○	○	○	agree

3.

The walking shoes above is appealing.

	-3	-2	-1	0	1	2	3	
disagree	○	○	○	○	○	○	○	agree

4.

The walking shoes above is appealing.

	-3	-2	-1	0	1	2	3	
disagree	○	○	○	○	○	○	○	agree

The above part of Rating Aesthetics was not displayed for the unprimed group --- the control group of the priming factor.

APPENDIX C

EXPERIMENT SCENARIO

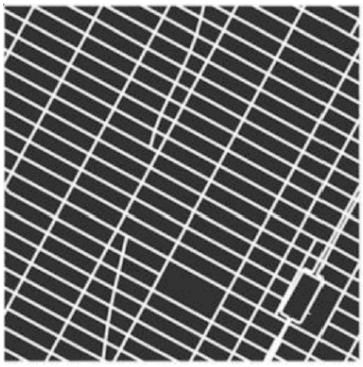
Scenario

Please imagine you are a tourist, travelling in a city.

You are on your holiday, away from your ordinary work and study.

You are traveling as a tourist in a **safe, tranquil and clean** city.

Upon inquiry, you got to know the city where you are traveling has grid-like street networks, just like street paterns in NYC, as is shown in the following picture. But this city you are travelling is **moderately populated**.



It's a day with no wind, no rain, decent sunlight and modest temperature (69°F / 21°C).

You are about to go to a tourist attraction named Bustle Escape. This tourist attraction is _2 miles_ away from the hotel you live in.

You have prepared all the needed navigation tools, including electronic maps and paper maps.

APPENDIX D
SALIENCE MANIPULATION

The below was shown for the un-colored sidewalks group --- the control group of the salience factor:

Before leaving your room, you look out the windows. You see the street views:

Street view 1

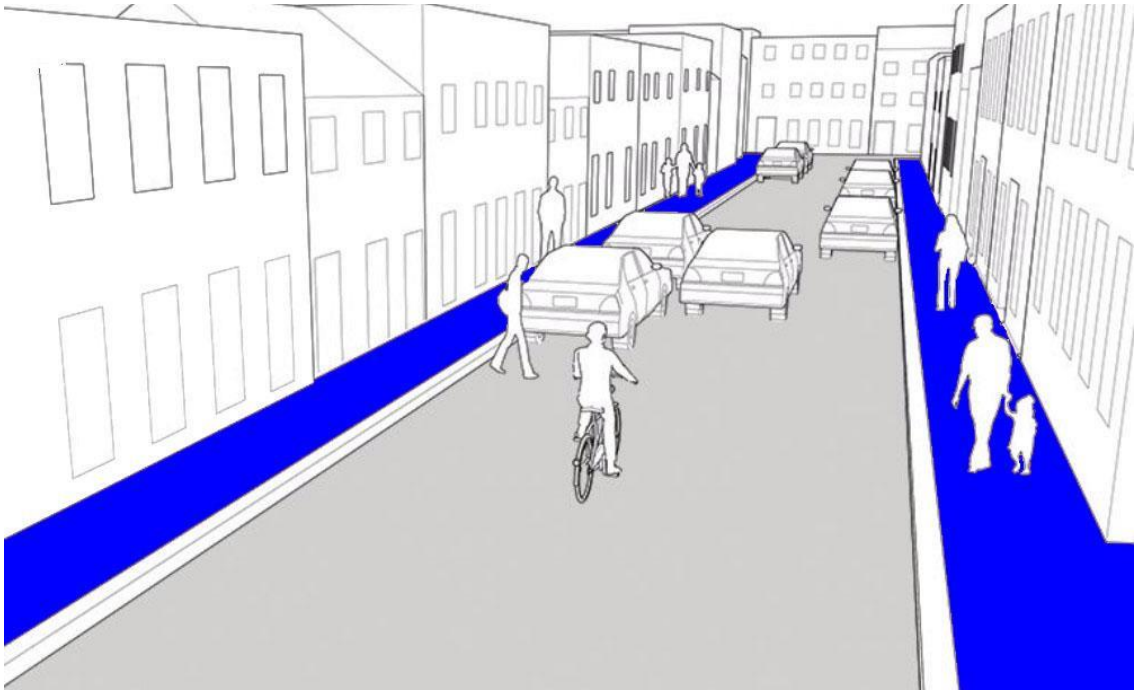
Street view 2

The below was shown for the blue-colored sidewalks group --- the 1st treatment group of the salience factor:

Before leaving your room, you look out the windows. You find the sidewalks were paved blue, as below:

Street view 1

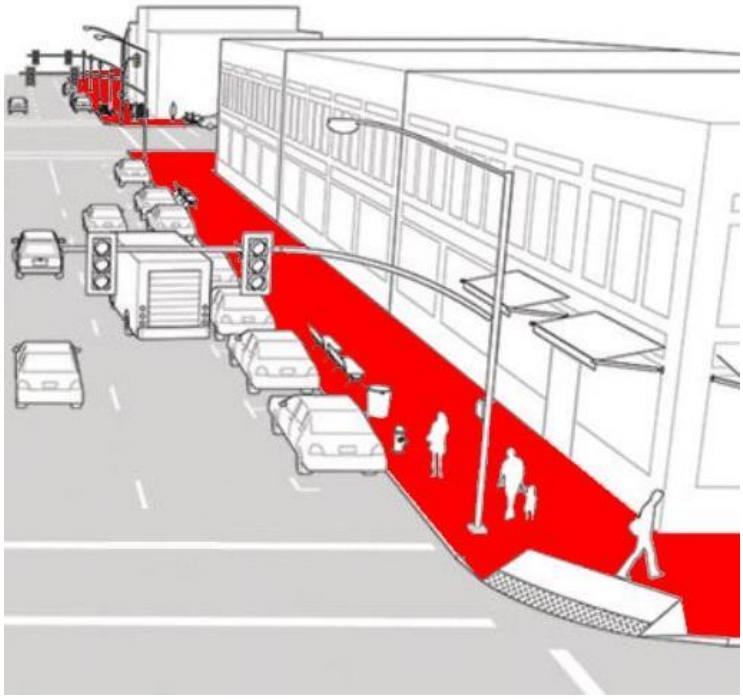
Street view 2



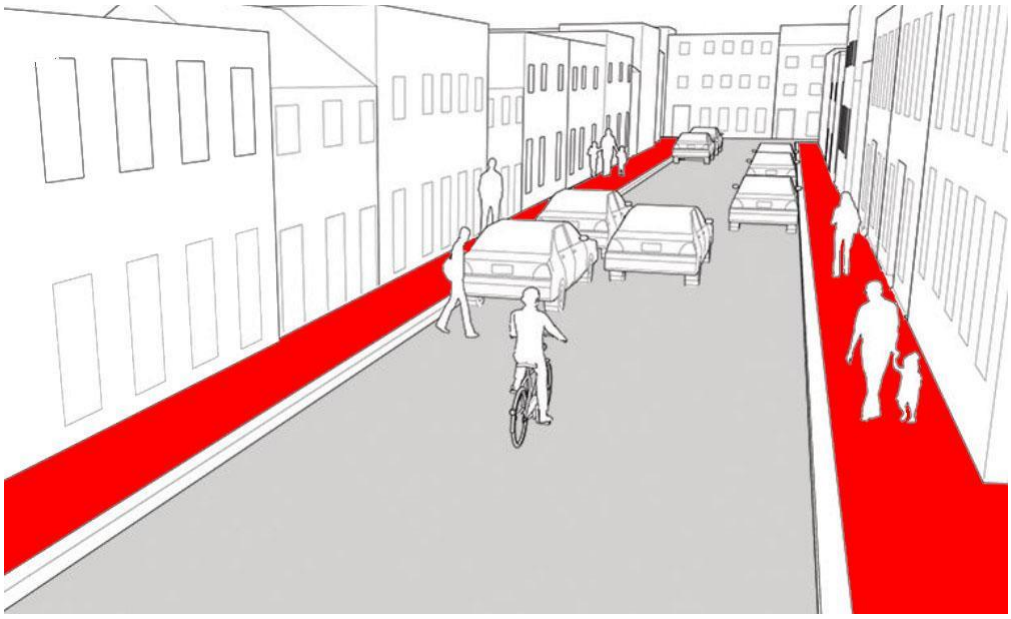
The below was shown for the red-colored sidewalks group --- the 2nd treatment group of the salience factor:

Before leaving your room, you look out the windows. You find the sidewalks were paved red, as below:

Street view 1



Street view 2



APPENDIX E

NORMS MANIPULATION

No norms were shown for the control group of the norms factor.

The below was shown for the tradition-norm group --- the 1st treatment group of the norms factor:

After seeing the views out of the window, you are about to leave your room. As you leave your room, you saw the following message on your room door:

When the distance is less than 2.5 miles, 3 out of 4 people (75% of people) choose to walk rather than take motor traffic.

The below was shown for the identification-norm group --- the 2st treatment group of the norms factor:

After seeing the views out of the window, you are about to leave your room. As you leave your room, you saw the following message on your room door:

When the distance is less than 2.5 miles, 3 out of 4 tourists (75% of tourists) --- who are travelling in this city --- choose to walk rather than take motor traffic.

APPENDIX F
QUESTIONNAIRE

Questionnaire:

1. I think walking to the tourist attraction would be:

	1	2	3	4	5	6	7	
extremely boring	○	○	○	○	○	○	○	extremely exciting

2. I think walking to the tourist attraction would be:

	1	2	3	4	5	6	7	
extremely unenjoyable	○	○	○	○	○	○	○	extremely enjoyable

3. I think the sidewalks are easy to be noticed.:

	1	2	3	4	5	6	7	
extremely disagree	○	○	○	○	○	○	○	extremely agree

4. Compared to the street views of those cities where you once travelled in real life, how attractive do you think the above street views are?

	1	2	3	4	5	6	7	
extremely unattractive	○	○	○	○	○	○	○	extremely attractive

5. Do you intend to walk to Bustle Escape?

	1	2	3	4	5	6	7	
definitely not	○	○	○	○	○	○	○	definitely yes

6. Please answering three questions regarding your exercise behavior within the past four months:

	0 (never)	1	2	3	4	5	6	7 or more times
How many times a week do you engage in non-sport aerobic exercise (e.g., walking, stationary cycling)?	○	○	○	○	○	○	○	○
How many times a week do you take part in sports that include aerobic exercise (e.g., basketball and soccer)?	○	○	○	○	○	○	○	○
How many times a week do you engage in aerobic exercise for at least 30 minutes?	○	○	○	○	○	○	○	○

7. In general, your health status is:

○ Excellent	○ Very good	○ Good	○ Fair	○ Poor

8. Please specify you age: _____

9. You identify your gender as:

- ○ Male
- ○ Female

10. Your employment situation is:

- ○ Employed
- ○ Self employed
- ○ Unemployed and seeking work
- ○ Looking after family or home / not seeking work
- ○ Retired
- ○ In full time education
- ○ Other

11. What is the highest level of education you have completed or are enrolled currently?

- ○ High School
- ○ Bachelor's Degree
- ○ Master's Degree
- ○ Ph.D.
- ○ Others

12. What is your annual household income? (in U.S. dollars)

○ Less than $10,000	○ $70,000 - $79,999
○ $10,000 - $19,999	○ $80,000 - $89,999
○ $20,000 - $29,999	○ $90,000 - $99,999
○ $30,000 - $39,999	○ $100,000 - $149,999
○ $40,000 - $49,999	○ $150,000 - $199,999
○ $50,000 - $59,999	○ Over $200,000
○ $60,000 - $69,999	○ Prefer not to tell

13. Which industry you primarily work in?

○ Health services	○ Construction
○ Education services	○ Financial activities
○ Wholesale and retail trade	○ Transportation and utilities
○ Professional and business services	○ Public administration
○ Manufacturing	○ Information
○ Leisure and hospitality	○ Other

Thank you for you participation and contribution to the research!

APPENDIX G
PAIRWISE COMPARISONS

Pairwise Comparisons of Factor Level Combinations

Sample 1 - Sample 2[b]	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
N-I	315.282	61.261	5.147	0.000	0.000
E-I	-286.500	60.776	-4.714	0.000	0.000
N-G	285.057	61.518	4.634	0.000	0.001
E-G	-256.275	61.035	-4.199	0.000	0.004
O-I	238.369	57.918	4.116	0.000	0.006
Q-I	230.101	59.446	3.871	0.000	0.017
C-I	-228.146	59.870	-3.811	0.000	0.021
N-P	-242.170	65.970	-3.671	0.000	0.037
O-G	208.143	58.190	3.577	0.000	0.053
K-I	207.034	58.462	3.541	0.000	0.061
Q-G	199.876	59.711	3.347	0.001	0.125
C-G	-197.921	60.132	-3.291	0.001	0.153
N-H	217.233	66.429	3.270	0.001	0.164
E-P	-213.388	65.519	-3.257	0.001	0.172
N-A	205.472	63.789	3.221	0.001	0.195
R-I	179.194	56.767	3.157	0.002	0.244
N-B	193.136	62.800	3.075	0.002	0.322
K-G	176.809	58.731	3.010	0.003	0.399
F-I	-165.275	57.242	-2.887	0.004	0.594
E-H	-188.451	65.982	-2.856	0.004	0.656
N-D	183.249	64.521	2.840	0.005	0.690
E-A	176.690	63.323	2.790	0.005	0.806
N-L	180.403	66.197	2.725	0.006	0.983
A-G	-79.585	58.919	-1.351	0.177	1.000
A-H	-11.761	64.030	-0.184	0.854	1.000
A-I	-109.810	58.651	-1.872	0.061	1.000
A-P	-36.698	63.553	-0.577	0.564	1.000
B-A	12.336	60.256	0.205	0.838	1.000
B-G	-91.921	57.847	-1.589	0.112	1.000
B-H	-24.097	63.045	-0.382	0.702	1.000
B-I	-122.146	57.573	-2.122	0.034	1.000
B-P	-49.034	62.560	-0.784	0.433	1.000
C-A	118.337	62.454	1.895	0.058	1.000
C-B	106.000	61.443	1.725	0.084	1.000
C-D	-96.114	63.201	-1.521	0.128	1.000
C-F	-62.871	61.132	-1.028	0.304	1.000
C-H	-130.098	65.148	-1.997	0.046	1.000
C-J	-82.872	62.454	-1.327	0.185	1.000
C-K	-21.113	62.277	-0.339	0.735	1.000
C-L	-93.267	64.911	-1.437	0.151	1.000
C-M	-82.901	62.277	-1.331	0.183	1.000

Appendix G continued

C-P	-155.035	64.680	-2.397	0.017	1.000
C-R	-48.953	60.688	-0.807	0.420	1.000
D-A	22.223	62.048	0.358	0.720	1.000
D-B	9.887	61.030	0.162	0.871	1.000
D-G	-101.808	59.711	-1.705	0.088	1.000
D-H	-33.984	64.759	-0.525	0.600	1.000
D-I	-132.033	59.446	-2.221	0.026	1.000
D-P	-58.921	64.288	-0.917	0.359	1.000
E-B	164.354	62.326	2.637	0.008	1.000
E-C	58.354	64.453	0.905	0.365	1.000
E-D	154.467	64.060	2.411	0.016	1.000
E-F	-121.225	62.020	-1.955	0.051	1.000
E-J	-141.226	63.323	-2.230	0.026	1.000
E-K	-79.466	63.148	-1.258	0.208	1.000
E-L	-151.621	65.748	-2.306	0.021	1.000
E-M	-141.255	63.148	-2.237	0.025	1.000
E-O	-48.132	62.645	-0.768	0.442	1.000
E-Q	-56.399	64.060	-0.880	0.379	1.000
E-R	-107.307	61.582	-1.743	0.081	1.000
F-A	55.466	59.939	0.925	0.355	1.000
F-B	43.129	58.885	0.732	0.464	1.000
F-D	33.243	60.717	0.547	0.584	1.000
F-G	-135.050	57.516	-2.348	0.019	1.000
F-H	-67.227	62.742	-1.071	0.284	1.000
F-J	-20.001	59.939	-0.334	0.739	1.000
F-L	-30.396	62.496	-0.486	0.627	1.000
F-M	-20.030	59.754	-0.335	0.737	1.000
F-P	-92.164	62.255	-1.480	0.139	1.000
G-I	-30.225	56.173	-0.538	0.591	1.000
H-G	67.823	61.768	1.098	0.272	1.000
H-I	-98.049	61.512	-1.594	0.111	1.000
H-P	-24.937	66.203	-0.377	0.706	1.000
J-A	35.464	61.286	0.579	0.563	1.000
J-B	23.128	60.256	0.384	0.701	1.000
J-D	13.241	62.048	0.213	0.831	1.000
J-G	115.049	58.919	1.953	0.051	1.000
J-H	47.225	64.030	0.738	0.461	1.000
J-I	145.274	58.651	2.477	0.013	1.000
J-L	-10.395	63.789	-0.163	0.871	1.000
J-M	-0.029	61.106	0.000	1.000	1.000
J-P	-72.162	63.553	-1.135	0.256	1.000
K-A	97.224	61.106	1.591	0.112	1.000
K-B	84.888	60.072	1.413	0.158	1.000

Appendix G continued

K-D	75.001	61.869	1.212	0.225	1.000
K-F	41.758	59.754	0.699	0.485	1.000
K-H	108.985	63.857	1.707	0.088	1.000
K-J	61.760	61.106	1.011	0.312	1.000
K-L	-72.155	63.615	-1.134	0.257	1.000
K-M	-61.788	60.925	-1.014	0.310	1.000
K-P	-133.922	63.379	-2.113	0.035	1.000
K-R	-27.840	59.300	-0.469	0.639	1.000
L-A	25.069	63.789	0.393	0.694	1.000
L-B	12.733	62.800	0.203	0.839	1.000
L-D	2.847	64.521	0.044	0.965	1.000
L-G	104.654	61.518	1.701	0.089	1.000
L-H	36.831	66.429	0.554	0.579	1.000
L-I	134.879	61.261	2.202	0.028	1.000
L-P	-61.768	65.970	-0.936	0.349	1.000
M-A	35.436	61.106	0.580	0.562	1.000
M-B	23.100	60.072	0.385	0.701	1.000
M-D	13.213	61.869	0.214	0.831	1.000
M-G	115.020	58.731	1.958	0.050	1.000
M-H	47.197	63.857	0.739	0.460	1.000
M-I	145.246	58.462	2.484	0.013	1.000
M-L	10.366	63.615	0.163	0.871	1.000
M-P	-72.134	63.379	-1.138	0.255	1.000
N-C	87.136	64.911	1.342	0.179	1.000
N-E	28.782	65.748	0.438	0.662	1.000
N-F	150.007	62.496	2.400	0.016	1.000
N-J	170.008	63.789	2.665	0.008	1.000
N-K	108.248	63.615	1.702	0.089	1.000
N-M	170.036	63.615	2.673	0.008	1.000
N-O	-76.914	63.116	-1.219	0.223	1.000
N-Q	-85.181	64.521	-1.320	0.187	1.000
N-R	-136.088	62.061	-2.193	0.028	1.000
O-A	128.559	60.586	2.122	0.034	1.000
O-B	116.223	59.544	1.952	0.051	1.000
O-C	10.222	61.766	0.165	0.869	1.000
O-D	106.336	61.356	1.733	0.083	1.000
O-F	73.093	59.223	1.234	0.217	1.000
O-H	140.320	63.360	2.215	0.027	1.000
O-J	93.094	60.586	1.537	0.124	1.000
O-K	31.335	60.403	0.519	0.604	1.000
O-L	103.489	63.116	1.640	0.101	1.000
O-M	93.123	60.403	1.542	0.123	1.000
O-P	-165.257	62.878	-2.628	0.009	1.000

Appendix G continued

O-Q	-8.267	61.356	-0.135	0.893	1.000
O-R	-59.175	58.764	-1.007	0.314	1.000
P-G	42.887	61.273	0.700	0.484	1.000
P-I	73.112	61.015	1.198	0.231	1.000
Q-A	120.292	62.048	1.939	0.053	1.000
Q-B	107.956	61.030	1.769	0.077	1.000
Q-C	1.955	63.201	0.031	0.975	1.000
Q-D	98.069	62.800	1.562	0.118	1.000
Q-F	64.826	60.717	1.068	0.286	1.000
Q-H	132.053	64.759	2.039	0.041	1.000
Q-J	84.827	62.048	1.367	0.172	1.000
Q-K	23.068	61.869	0.373	0.709	1.000
Q-L	95.222	64.521	1.476	0.140	1.000
Q-M	84.856	61.869	1.372	0.170	1.000
Q-P	156.990	64.288	2.442	0.015	1.000
Q-R	-50.908	60.270	-0.845	0.398	1.000
R-A	69.384	59.486	1.166	0.243	1.000
R-B	57.048	58.424	0.976	0.329	1.000
R-D	47.161	60.270	0.782	0.434	1.000
R-F	13.918	58.097	0.240	0.811	1.000
R-G	148.968	57.044	2.611	0.009	1.000
R-H	81.145	62.309	1.302	0.193	1.000
R-J	33.919	59.486	0.570	0.569	1.000
R-L	44.314	62.061	0.714	0.475	1.000
R-M	33.948	59.300	0.572	0.567	1.000
R-P	106.082	61.819	1.716	0.086	1.000

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

b. Each letter represents a combination factor levels. Alphabetical interpretation is as follows.

Alphabetical interpretation:

A: Primed/BlueColored/IdentificationNorm
B: Primed/BlueColored/NoNorm
C: Primed/BlueColored/TraditionalNorm
D: Primed/UnColored/IdentificationNorm
E: Primed/UnColored/NoNorm
F: Primed/UnColored/TraditionalNorm
G: Primed/RedColored/IdentificationNorm
H: Primed/RedColored/NoNorm
I: Primed/RedColored/TraditionalNorm
J: Unprimed/BlueColored/IdentificationNorm
K: Unprimed/BlueColored/NoNorm
L: Unprimed/BlueColored/TraditionalNorm
M: Unprimed/UnColored/IdentificationNorm
N: Unprimed/UnColored/NoNorm
O: Unprimed/UnColored/TraditionalNorm
P: Unprimed/RedColored/IdentificationNorm
Q: Unprimed/RedColored/NoNorm
R: Unprimed/RedColored/TraditionalNorm