

Can colored sidewalk nudge city tourists to walk? An experimental study of the effect of nudges

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ABSTRACT

Physical inactivity has been an increasing sub-health condition. Nudging people to participate in physical activities consequently becomes a public health priority. This study aims to showcase how color as a design factor can work to nudge city travelers to take on walking. Alongside the color effect, this experimental study incorporates another two design factors, namely, priming and social norms. The findings suggest that the use of colored sidewalks stimulate perceptual salience and individuals' moods, thereby increasing travelers' desire for walking. Priming tourists with sneakers and displaying social norms were also found to increase travelers' interest in walking. The current study is innovative in incorporating color in the design of walkable routes in cities for its visitors. It is the first to apply nudges into the context of walkable city design oriented towards tourists.

1. Introduction

Sedentary lifestyles are on the rise globally. The World Health Organization has identified the lack of physical exercise as an urgent global wellness issue to be addressed (World Health Organization, 2021). Encouraging people to participate in moderate-intensity physical activity consequently has become a public health priority (Carlson, Adams, Yang, & Fulton, 2018). Walking for example effectively decreases the incidence rate of many different chronic diseases and contributes significantly to our overall body quality (Cole, Leslie, Bauman, Donald, & Owen, 2006; Rafferty, Reeves, McGee, & Pivarnik, 2002). For these and other reasons, walking is one of the most recommended forms of light- and moderate-intensity activity (Chastin et al., 2019; Kelly et al., 2018; Slaght, Sénechal, Hrubeniuk, Mayo, & Bouchard, 2017). In tourism, especially in the context of urban tourism, city walkability has recently become a topic of investigation, as destinations are increasingly aware of the role that tourism can play in promoting public health (Lehto & Lehto, 2019).

Previous research in urban planning has recognized a walkable urban design – a built environment that's pedestrian-friendly and promotes walking – as a necessity for residents to participate in walking. It is well recognized that attaining this objective requires consideration of factors such as the distance to public transport, sidewalk safety, sidewalk connectivity and proximity to neighborhood businesses, diversity of land use, and esthetics of the surroundings (Cervero & Kockelman,

1997; Ewing et al., 2013; Krambeck & Shah, 2006; Moura, Cambra, & Gonçalves, 2017). However, it has been recognized that urban planners have not fully considered the needs of tourists as they do not have the same spatial familiarities nor motivational and other drives as residents (Hall & Ram, 2021; Ram & Hall, 2018). Motivations of walking in tourists may be due to exploring novelty, improving the quality of tourist experience, seeking authenticity, building place attachment, and improving mental and physical well-being (Girish & Lee, 2020; Ujang & Zakariya, 2015), whereas residents mainly walk for school, commuting, shopping, and other utilitarian purposes. Moreover, unlike permanent residents, tourists are likely to be on a limited time budget that constrains their activity space and to have limited knowledge of the urban space which creates different perception of safety. They also are likely to spend more time walking than residents since walking at the destination is often integral to their traveling experience (Ram & Hall, 2018). To encourage tourists' walking behaviors, studies in tourism thereby need to understand walkable design factors beyond the urban planning literature.

One walkable design factor that has drawn research attention is the use of color. Color is recognized as a design element that can produce profound psychological and physiological reactions (Valdez & Mehrabian, 1994). Physiologically, for example, red causes the heart to beat faster and an increase in blood pressure. Psychological responses to color include changes in mood and attention (Bellizzi & Hite, 1992; Singh, 2006). The physiological and psychological reactions can in turn

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influence behaviors (Mehrabian & Russell, 1974) such as walking. As an important design factor, color has been utilized in various contexts of the built environment (e.g. Barnes, 2022; Mokhtar, 2021; Tantanatewin & Inkarojrit, 2018). However, color, seen as one of the most important design elements of the built environment, hasn't attracted much attention in walkable design. Further, the use of color in walkable design for tourists is non-existent. This research set out to address this gap by examining whether color could be an effective design factor to nudge tourists to walk. The nudging effect of color became the prioritized research problem in this study.

Although walkable design has traditionally focused more on the physical characteristics of the built environment, this study also considered two other nudge factors for the social environment in walkable design for travelers: the use of priming and social norms. Since an individual's living environment is inseparable from both social and built environments, an intact walkable design should consider both aspects. In their work, Thaler and Sunstein (2009) emphasizes the social influence of social norms and priming. They note that social norms and priming are two important social nudges (Thaler & Sunstein, 2009). Priming refers to the merest hint of an idea or concept will trigger an association that can stimulate action, such as people tend to walk more slowly after being primed with elderly-related words like "wrinkle" (Bargh & Chartrand, 1999). Social norms simply inform people about what other people are doing and prompt them to conform to the majority, such as an individual is likely to choose walking instead of motorized transport after knowing most people choose to walk (McNeill, Kreuter, & Subramanian, 2006). In tourism research, social norms and priming are accepted as a powerful nudge of sustainable behaviors (Kim & Hyun, 2021; Souza-Neto, Marques, Mayer, & Lohmann, 2022). However, there is little discussion about the effectiveness of priming and social norms in walkable design for tourists.

Against these backgrounds, our study conducted an experiment to investigate how to nudge tourists to walk under an urban context. The fundamental proposition of our study is that making small changes to the built environment and social environment will promote tourists' walking desire. More specifically, we argue that increasing the salience of sidewalks by painting them in colors can play a role in nudging tourists' walking interest, by grabbing their attention to the walkways and triggering positive emotions and interest in walking activity. To study this proposition, one part of our experiment compared tourists' walking interests when sidewalks are colored and uncolored. In addition, we explored the effect of priming on tourists' choices and behaviors, specifically, whether priming tourists by first asking them to compare walking shoes can play a role in nudging them to walk. In this second layer of our experiment, we compared tourists' walking interest between those who are primed and those who are not primed with walking shoes in a hotel room. Third, this study considered the effects of social norms on tourists' walking behavior. That is, we further compared tourists' interest in walking when social norms are absent or present.

This research is in line with the frequent call for increased research effort to better understand how hospitality and tourism can contribute to the enhancement of individuals' health and wellness (Lehto & Lehto, 2019). More specifically, the results of this study shed light on the effectiveness of design factors in the built and social environments in nudging city tourists to be physically more active.

2. Development of hypotheses

The theory of nudges holds that indirect environmental cues are an effective way to alter behavior, because those environmental cues play an important role in influencing "System 1" where our brain reacts fast, intuitively, and automatically (Evans, 2008). Psychology and neuroscience agree that behavior is the result of both conscious and non-conscious processes of the brain (Bargh & Ferguson, 2000; Heatherton & Wagner, 2011). Conscious responses are a result of the cognitive system (System 2), whereas unconscious responses are a result

of the automatic system (also called "System 1") (Chaiken & Trope, 1999). This dual systems model laid the foundations for further conjectures of nudges. As a result of the effect of System 1, small changes made to the environment become environmental cues that can nudge behaviors without mandatorily requiring the behaviors to be followed or restricting choices (Thaler & Sunstein, 2009). Different forms of nudges have been proposed and studied by researchers in the field of behavioral economics (Samson, List, Bohnet, & Chilazi, 2021). Examples include the use of nudges to promote healthy food choices (Vecchio & Cavallo, 2019) and to increase physical activity (Forberger, Reisch, Kampfmann, & Zeeb, 2019). For instance, putting healthy food at eye level becomes an environmental cue that nudges consumption of healthy food (Wilson, Buckley, Buckley, & Bogomolova, 2016); placing stairs nearby is another environmental cue that nudges people to take stairs instead of taking the elevator (Blumenthal-Barby & Burroughs, 2012).

The differences between daily life scenarios for residents and traveling scenarios for tourists suggest that design for tourists is unique. Some of the leading factors in creating a walkable urban design for tourists cited in previous studies include 1) accessibility to toilets and Wi-Fi (Ram & Hall, 2018), 2) connectivity among attractions, hotels, restaurants and shoppings (Mansouri & Ujang, 2017; Sharipov & Demirkol, 2018), 3) comfort, safety, attractiveness and pleasantness of the built environment (Mansouri & Ujang, 2017; Ram & Hall, 2017; Ujang & Muslim, 2014). Relevant to walkable design for tourists, Kim and Hall (2021, 2022) emphasized that walking as a tourist is different from walking as a resident as they further recognized the importance of social and health dimensions in walkable design for tourists. It is worth noting that Lynch (1964) suggested walkable design should differ in familiar and unfamiliar environments, because people navigate differently in each context. In a familiar environment, people rely on their mental maps to find the correct path to the destinations, while in an unfamiliar environment, people often have to rely on navigational aids, such as signage system, paper maps, and digital maps, to help them orient (Lynch, 1964).

2.1. Nudging with colored sidewalks

Color has symbolic meanings. Meanings differ between cultures, but some interpretations gradually share common points (Gorzaldini, 2016). For example, red is associated with energy, blue signals calmness, gray indicates neutrality, and white speaks for purity (Tham et al., 2020). With the symbolism attribute, color becomes a communication tool and plays a role in shaping people's attitudes. Studies in marketing have found that color drives more than half of people's appraisal of a product (Singh, 2006), simulates their interest in purchasing products (Funk & Ndubisi, 2006), and can be used strategically to influence consumers' buying desire (Ahmed Javed & Javed, 2015; Labrecque & Milne, 2012). Studies of color's effect on nudging healthy choices are limited, but given the evidence in marketing that color influences both salience and people's buying desire, we conjecture that color may also be used as a nudging strategy. That is, we hypothesized:

H1a. Colored sidewalks will increase tourists' interest in walking compared to uncolored sidewalks.

Hue is the first attribute of a color. Hue represents the perceived spectrum color, commonly referred to by the color names (e.g., red, yellow, green, blue, purple). Colors having any amount of a hue are chromatic colors. On the contrary, colors lack of hues are achromatic colors, including white, black, and gray. Studies found people react emotionally positively (e.g., feel enjoyable and exciting) to hues but negatively (e.g., feel sad and lonely) to achromatic colors (Kaya & Epps, 2004; Valdez & Mehrabian, 1994). To extend it further, psychologically, cool colors are identified with peaceful, calm and restful states (Sharpe, 1975), and warm colors are emotionally arousing (Bellizzi & Hite, 1992) and are associated with exciting themes, such as boldness, adventurousness, advancement, and vitality (Aaronson, 1970; Yildirim,

([Hidayetoglu, & Capanoglu, 2011](#)). On the contrary, for achromatic colors, white elicits the feelings of loneliness and boredom, gray and black bring about sadness and depression ([Kaya & Epps, 2004](#)), and gray was tested attaining the most negative response. However, in daily life, sidewalks are usually not colored. We referred to these nude sidewalks with achromatic colors as “uncolored sidewalks” in the context of this study. By contrast, sidewalks with chromatic colors were referred to as “colored sidewalks.” We propose that the uncolored sidewalks are much less likely to trigger tourists’ positive emotional states, compared with colored sidewalks. Since enjoyment and excitement are two typically positive emotional states related to chromatic colors, we hypothesized the following:

H1b. Colored sidewalks bring more perceived enjoyment, compared with uncolored sidewalks.

H1c. Colored sidewalks bring more perceived excitement, compared with uncolored sidewalks.

Another attribute of color is lightness (value), referring to the darkness of a hue as in relation to white and black. Lightness is like a light bulb. When a color has zero lightness, the bulb turns off and the hue is perceived black. On the contrary, a hue with full lightness is perceived white. To attain a perceptually “normal” hue, lightness needs to be “balanced” (i.e., fifty percent of lightness). The last attribute of color is saturation (chroma). To put it simply, saturation measures a hue’s purity. A hue with full saturation is pure in that it contains no shades of gray. In contrast, a hue with zero saturation corresponds to a gray shade. Under this circumstance, adjusting the lightness of the fully desaturated hue will attain different degree of a gray shade (i.e., a darker or lighter gray). Studies found a hue’s lightness and saturation levels are of vital importance in attracting attention ([Camgöz, Yener, & Güvenç, 2004](#); [Johns & Sumner, 1948](#); [Taylor & Sumner, 1945](#)). When a hue is with balanced lightness and fully saturated, the hue attracts the most attention ([Camgöz et al., 2004](#)). In other words, fully desaturated color (i.e., gray) and extremely unbalanced lightness colors (i.e., white, black) attract least attention, which implies that sidewalks with achromatic colors (i.e., uncolored sidewalks) are the least eye-catching. Therefore, based on the saturation-lightness theory of color in attracting attention, we hypothesized:

H1d. Colored sidewalks are more likely to attract tourists’ attention, compared with uncolored sidewalks.

Positive emotions and focused attention are two essential aspects that trigger interest ([Chen, Darst, & Pangrazi, 1999](#)). When an individual experiences positive emotion for an activity, interest occurs because the positive emotion creates a strong motivational incentive for the individual to engage in the activity ([Schraw & Lehman, 2001](#)). In education, whether a student feels an activity enjoyable and exciting, it positively influences her/his perception of interest in the activity ([Chen et al., 1999](#)). On the other hand, to promote interest, an activity also needs to grab the person’s attention. For example, attracting readers’ attention by text content or structural aspects of a text induces their interest in reading ([Schraw & Lehman, 2001](#)). Therefore, we believe the attention and positive emotions that are brought by colored sidewalks will affect tourists’ walking interest. Specifically, we hypothesized the following:

H2. Enjoyment brought by colored sidewalks increases tourists’ interest to walk.

H3. Excitement brought by colored sidewalks increases tourists’ interest to walk.

H4. Attention caught by colored sidewalks increases tourists’ interest to walk.

Positive emotions and attention may mediate the relationship between color and tourists’ interest. As discussed before, chromatic color is likely to trigger people’s positive emotions. Meanwhile, positive emotions have potentials in promoting people’s interest in an activity.

Therefore, when chromatic colors form people’s interest, positive emotions may be a mediator in the mechanism. In this study, positive emotions may mediate the effect of colored sidewalks on tourists’ interest to walk. On the other hand, chromatic colors lead to focused attention, and attention is another contributor to interest. Therefore, when chromatic colors pique people’s interest, attention becomes another mediator in the mechanism. In this study, attention may mediate the effect of colored sidewalks on tourists’ interest to walk. The following hypotheses were suggested:

H5. Tourists’ enjoyment mediates the effect of colored sidewalks on their walking interest.

H6. Tourists’ excitement mediates the effect of colored sidewalks on their walking interest.

H7. Tourists’ attention mediates the effect of colored sidewalks on their walking interest.

2.2. Nudging with social norms and by priming

Social norms are a powerful influence on behavior, pushing individuals to make choices aligning themselves with their peer groups ([Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007](#)). A number of studies have focused on communicating social norms as a nudging strategy to encourage choices that improve the public health, focusing of goals such as discouraging drinking behavior, promoting health food choices, and stimulating physical examinations ([Borsari & Carey, 2003](#); [Gonçalves, Coelho, Martinez, & Monteiro, 2021](#); [Stok, De Vet, de Ridder, & de Wit, 2016](#); [von Wagner et al., 2019](#)). One finding is that communicating descriptive social norms (i.e., our perception of what most others actually do) tends to have a more powerful effect than communicating injunctive social norms (i.e., our perception of what most others approve) ([Stok et al., 2016](#)). Studies of health interventions have shown that descriptive social norms greatly influence young people’s willingness to take vaccine ([Sinclair & Agerström, 2021](#)), positively relate to college students’ intent to exercise at leisure time ([Okun, Karoly, & Lutz, 2002](#)), and powerfully increase women’s interest to add chemotherapy to hormonal therapy ([Zikmund-Fisher, Windschitl, Exe, & Ubel, 2011](#)). Based on these studies, we propose that providing descriptive social norms can be an effective health intervention in nudging tourists to walk. More specifically, we hypothesize:

H8. Tourists exposed to descriptive social norm information about tourist walking behavior will be more interested in walking than those not provided this information.

Priming is a second commonly applied strategy used in marketing and elsewhere where information is provided as a nudge to influence expectations and how people react to subsequently provided information. From a theoretical view, priming is said to occur when exposure to a particular stimulus influences how a subsequent stimulus is responded to. Priming is often viewed as the result of a memory tracing process when different concepts linked across an associative memory network are triggered. When a concept fires, its activation spreads through the network and activates associated concepts ([Collins & Loftus, 1975](#)). Therefore, priming using a concept such as “red” will activate its associative concepts such as “color” ([Collins & Loftus, 1975](#)). Studies have found primed concepts will influence people’s subsequent attitudes, including interest, without a person’s intent ([Carpentier, 2009](#); [Chartrand, Huber, Shiv, & Tanner, 2008](#); [Papies, 2016](#); [Rudman & Phelan, 2010](#)). For example, when women were primed with traditional gender roles (e.g., a male surgeon and a female nurse), they were found to show a decreased level of interest in pursuing masculine occupations ([Rudman & Phelan, 2010](#)); when recipients were primed with an extrinsic social goal, their interest in socially engaged news increased ([Carpentier, 2009](#)).

From the perspective of this study, this research assumes that priming tourists by asking them to evaluate the quality of “shoes” before

considering whether to participate in walking activity will activate an associative concept – “walking”, and this priming effect will then affect tourists’ interest to walk:

H9. Tourists primed by first evaluating shoes will be more interested in walking than those not primed.

Fig. 1 is a summary model that illustrates the relationships being examined.

3. Methodology

3.1. Scenarios

The research design includes a main scenario and several sub-scenarios. The main scenario controlled conventional walkable factors, including safety (Forsyth, 2015; Gorriini & Bertini, 2018), sanitation (Kirillova, Fu, Lehto, & Cai, 2014), weather (Böcker, Dijst, & Prillwitz, 2013), distance (Azmi, Karim, & Ahmad, 2013), street patterns (e.g., grid-like pattern is pedestrian-friendly) (Dill, 2004; Handy, Cao, & Mokhtarian, 2006), and population density (Pons, Laroche, & Mourali, 2006). In summary, to test the hypotheses (Fig. 1), a scenario-based experimental research design was adopted. The experiment consisted of a $3 \times 3 \times 2$ full-factorial between-subject design (Fig. 2), manipulating colors, descriptive social norms, and priming.

In the main scenario, each participant was asked to imagine she/he is traveling in a safe and clean city with grid-like street networks. Next, the participant was informed that the city is moderately populated, and was told that it is a day with no wind, no rain, decent sunlight, and modest temperature ($69^{\circ}\text{F}/21^{\circ}\text{C}$). Further, the participant was told she was about to go to a tourist attraction which is 2 miles away. A 2-mile walk was used in the scenario because the Centers for Disease Control and Prevention (CDC) and American Heart Association recommend walking for 30 minutes per day, which works out to a distance for many people of around 2 miles.

Sub-scenarios manipulated the focused factors of this study (i.e., color, descriptive norms, and priming). In manipulating sidewalk color, participants looked at two street-view sketches where the sidewalks were either uncolored or painted red or blue. The reason for choosing red is that red is the most eye-catching and has the highest visibility among all colors (White, 1990). Red has also shown to be emotionally arousing which, in turn, may activate energy and stimulate physical movements (Attrill, Gresty, Hill, & Barton, 2008; Bellizzi & Hite, 1992; Hill & Barton, 2005). Similarly, choosing blue as the color is because that blue is suggested to be universally preferred and most enjoyed than any other color by both females and males (Simon, 1971), especially in the United States where blue is regarded as being associated with “beautiful” and “pleasant” (Madden, Hewett, & Roth, 2000). In other words, red and blue have great potentials in evoking positive emotions

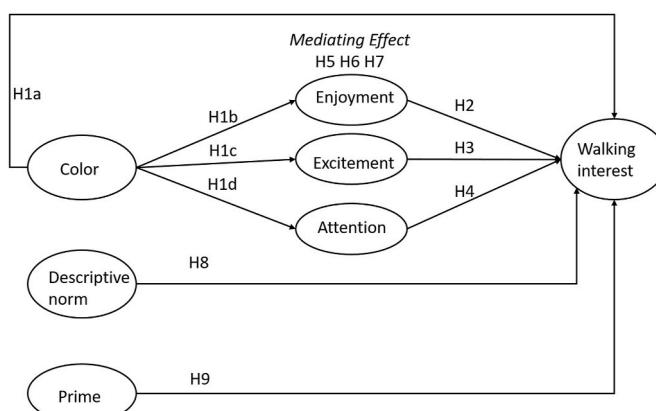


Fig. 1. Conceptual model.

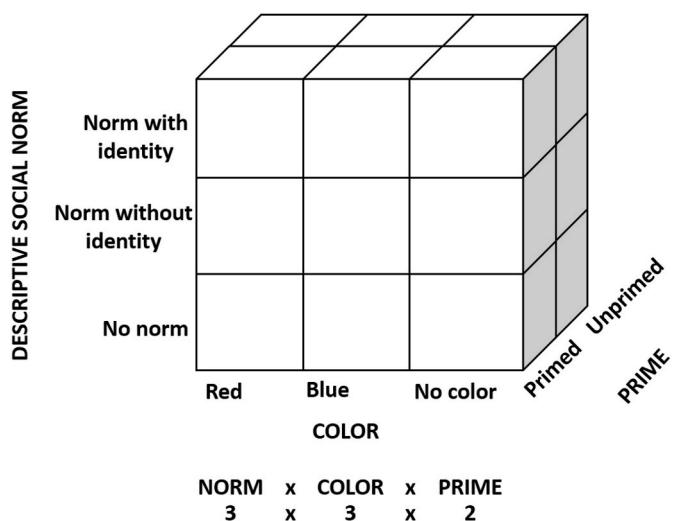


Fig. 2. Experimental design.

and catching attentions, which are the hypothetical mediating variables between color and walking interest to be tested in this study. Additionally, red and blue are near the opposite end of the color spectrum (Bellizzi, Crowley, & Hasty, 1983). That is, red is the hottest of the warm color and blue is the coldest cool color. Adopting red and blue colors gives us a chance to see if difference exists between cold and warm colors in walkable route design. To standardize participants’ interpretations of colors, we designed colors according to the three basic attributions of color, namely hue, saturation, and lightness. We generated a pure red with 0° hue, 100% saturation, 50% lightness, and a pure blue with 240° hue, 100% saturation, 50% lightness. The concepts of hue, saturation and lightness have been discussed in detail in 2.1 and thereby will not be repeated herein. All objects in the sketches were in black-and-white color, except sidewalks, in order to eliminate potential noise that may hinder us from testing the impacts of colored sidewalks.

In manipulating priming, this study primed the treatment group by asking participants to rate aesthetic quality of four pairs of walking shoes at the beginning of the survey (Iso-Ahola & Miller, 2016). To manipulate descriptive social norms, in the treatment group a descriptive social norm either with or without identity information was given. Both types of descriptive social norms were studied since previous studies found the degree to which an individual identifies with others may influence the extent to which she/he will adhere to the descriptive social norm (Burnkrant & Cousineau, 1975; Goldstein, Griskevicius, & Cialdini, 2007; Moschis, 1976). Therefore, we designed a descriptive social norm with identity information in this study to see if there’s difference between it and a descriptive norm without identity information in influencing tourists’ conformity to the majority. The descriptive norm without identity information was written as “3 out of 4 people (75% of people) choose to walk rather than take motor traffic”, and the descriptive norm with identity information was “3 out of 4 tourists (75% of tourists) who are traveling in this city choose to walk rather than take motor traffic”.

3.2. Procedure

As Fig. 3 illustrates, in the sub-scenario of priming, around one half of the participants were primed by asking them to evaluate four pairs of sneakers. They and all of the unprimed subjects then participated in the main scenario. In the main scenario, participants were asked to imagine they were tourists in a city. They then moved on to the sub-scenario of color in which participants were told “before leaving your room, you look out the windows. You see the street views”. One-third of the participants looked at the purely white-and-black sketches of street scenes;

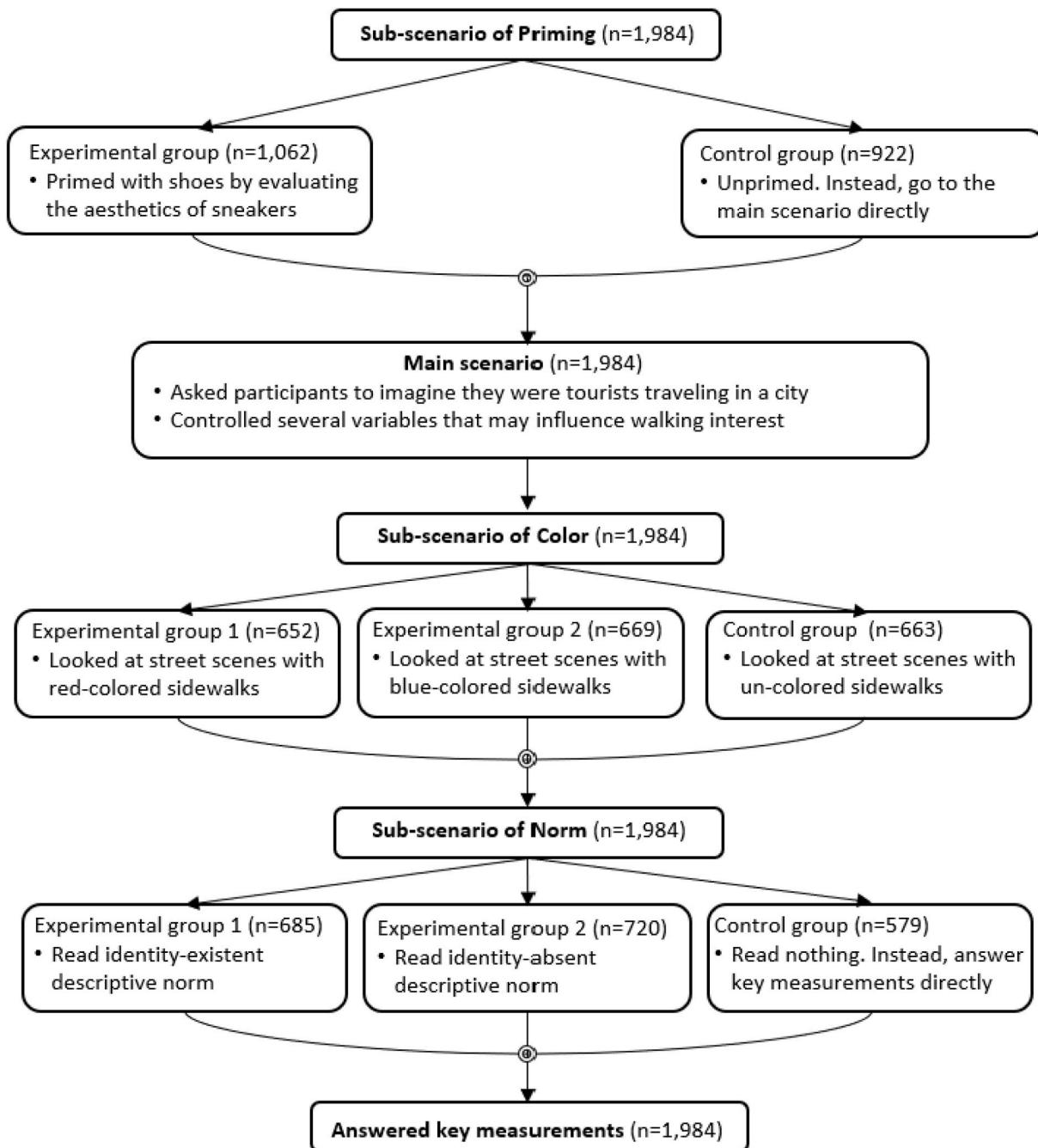


Fig. 3. Experimental procedure.

one-third of them looked at the sketches with blue-colored sidewalks; the remaining one-third looked at the sketches with red-colored sidewalks. In the next sub-scenario, one-third of the participants read the descriptive norm with identity information; one-third of them read the identity-absent descriptive norm of walking behavior; the remaining one-third was the control group who received no information about walking behavior of others. Each group then rated the key measurements, including their walking interest, enjoyment, excitement, and attention for the scenario. An example of the procedure followed where

a participant received effects of priming, red-colored sidewalks, and identity-absent descriptive norm is presented in Appendix A.

3.3. Key measurements

Researchers have attempted to establish and validate single-item self-reporting measures of physical activity. They suggest that a single-item self-report measurement performs as well as multi-dimensional self-reports (Milton, Bull, & Bauman, 2011; Milton, Clemes, & Bull,

2013). Adapted from previous studies (Chen et al., 1999; Renninger & Hidi, 2011; Rotgans & Schmidt, 2011), the current study utilized a single item requesting participants to answer “How interested you are in walking to the tourist attraction?” (1-not at all interested, 10-extremely interested). From a theoretical perspective, it follows that greater interest in walking should lead to choices by tourists that increase walking behavior. This follows because interest is both a basic emotional reaction and an important motivational variable that influence choices and behavior (Hidi, 2001). Among the many different models of interest that have been developed, one popularly recognized model distinguishes situational interest and personal interest (Hidi & Renninger, 2006). Personal interest is rooted in an individual’s intrinsic preference, whereas situational interest arises spontaneously from environmental factors which elicit interest by arousing affective qualities (e.g., feelings of enjoyment and excitement) and cognitive qualities (e.g., focused attention) (Hidi & Renninger, 2006). Situational interest also plays a role in shaping behavioral desires, particularly the participation of physical activity (Huang & Gao, 2013). Since the present study focuses on nudging participants in ways expected to encourage participation in walking, the focus in this study is on how the nudging strategies considered here influence situational interest.

Additionally, positive emotions were measured by answering “I think walking to the tourist attraction would be ...” with endpoints of “unenjoyable - enjoyable” (1-unenjoyable, 7-enjoyable) and “boring - exciting” (1-boring, 7-exciting). Attention was measured by asking if participants agree or disagree with the proposition: “I think the sidewalks are easy to be noticed” (1-strongly disagree, 7-strongly agree). Regarding control variables, perceived attractiveness of the street view and non-sport aerobic exercise frequency of participants were measured, because these two variables were found in previous studies as having great impacts on walking desire (Ding, Sallis, Kerr, Lee, & Rosenberg, 2011; Nasar, Holloman, & Abdulkarim, 2015; Ouellette, Hessling, Gibbons, Reis-Bergan, & Gerrard, 2005). Participants need to answer, “How many times a week do you engage in non-sport aerobic exercise (e.g., walking, stationary cycling)?” by selecting from 0 (never) to 6 or more times a week, and “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?” by rating on a 7-point scale (1-extremely unattractive, 7-extremely attractive).

3.4. Data collection and analysis methods

A total of 2,160 US respondents were recruited via Mechanical Turk (MTurk), an opt-in online panel that is increasingly being used in social science research. 1,984 respondents completed the survey and were used as the sample of this study for analysis. Specific sample sizes for the various groups in the experimental study are shown in Fig. 3. Since previous research has found that data quality from MTurk responses was promoted by paying a relatively high compensation (Kittur, Chi, & Suh, 2008), respondents participating our research were paid per completion rather than entered in lottery draws.

Stata 16.1 was used for data analysis. To identify the effect of colored sidewalks (H1a), descriptive norm (H8), and priming (H9) on participants’ walking interest, analysis of covariance (ANCOVA) was utilized. Independent variables were defined as colors (blue, red, no color), descriptive norms (with identity, without identity, no norm), and priming (primed, unprimed). Control variables (i.e., street-view attractiveness, exercise frequency) were included to prevent possible bias. The overall model is as follows:

$$\begin{aligned} \text{Walking Interest} = & \beta_0 + \beta_1 \text{Norm} + \beta_2 \text{Color} + \beta_3 \text{Priming} \\ & + \beta_4 \text{Streetview Attractiveness} \\ & + \beta_5 \text{Exercise Frequency} + \epsilon \end{aligned} \quad (1)$$

In order to test Hypothesis 1b, 1c and 1d, multivariate analysis of variance (MANOVA) was employed to examine whether significant

mean differences existed in enjoyment, excitement, and catching attention across different sidewalk colors, followed by a series of one-way ANOVA. For Hypotheses 2–4, ordinary linear regression was utilized to test the relationship among enjoyment, excitement, attention and walking interest. For Hypotheses 5–7, regressions were applied to measure the mediation of enjoyment, excitement and attention in the relationship between colored sidewalks and walking interest. Sobel tests were performed to test the indirect effects (Sobel, 1982).

4. Results

4.1. Manipulation check

Prior to proceeding to further analysis, it was necessary to conduct a manipulation check. A manipulation check confirms whether participants perceived the scenario as intended (Shadish, Cook, & Campbell, 2002). To identify whether participants correctly perceived the level of colored sidewalks, we asked participants to recall the color of sidewalks. Similarly, participants were asked to recall how many pairs of shoes they saw. To ensure participants perceived the descriptive social norm correctly, each treatment group was asked to recall whether the message that they saw was describing “the majority of tourists” or “the majority of people.” Samples retained for further analysis were those who passed the manipulation checks.

4.2. Demographics of respondents

Of the qualified 1,984 samples, approximately 60% was males and 40% was females. About half of the sample had a bachelor’s degree (55%). The average age of participants was 34. Exercise habits varied greatly among participants. Approximately 33% said they exercise less than three times a week, 39% said four to five times a week, and about 28% said they exercised more than six times a week. The majority of the sampled individuals rated their own health status as good or very good (72%). Table 1 displays the demographic profile of the respondents.

4.3. Hypothesis tests

4.3.1. Priming, color, and norm on walking interest

To test the hypothesized effects of color (H1a), norm (H8), and priming (H9) on walking interest, ANCOVA was conducted (Table 2). The results suggested that priming had a significant main effect on walking interest ($\text{Mean}_{\text{unprimed}} = 7.92$; $\text{Mean}_{\text{primed}} = 8.20$; $F = 7.42$, $p < .001$), implying that participants show more interest in walking when

Table 1
Respondents’ profile (N = 1984).

Demographics	n	%	Demographics	n	%
Gender			Ethnicity		
Female	838	42.24%	African American	131	6.60%
Male	1146	57.76%	Asian Pacific	489	24.65%
Age			Hispanic	68	3.43%
18–20	131	6.60%	White	1201	60.53%
21–29	749	37.75%	Native American	33	1.66%
30–39	607	30.59%	Other	62	3.13%
40–49	287	14.47%	Education		
50–59	121	6.10%	Hight school graduate	323	16.28%
60 or older	89	4.49%	Bachlor’s degree	1098	55.34%
Exercise Behavior (per week)			Master’s degree	444	22.38%
≤ 3 times	656	33.06%	Ph.D.	55	2.77%
4–5 times	775	39.06%	Other	64	3.23%
≥ 6 times	553	27.87%	Annual Income		
Health Status			Less than \$20,000	555	27.97%
Excellent	430	21.67%	20, 000–39,999	460	23.19%
Very good	829	41.78%	40, 000–69,999	460	23.19%
Good	601	30.29%	70, 000–99,999	262	13.21%
Fair	113	5.70%	100, 000–149,999	165	8.32%
Poor	11	0.55%	\$150,000 or more	82	4.13%

Table 2
ANCOVA table for walking interest.

Source	SS	df	MS	F	Sig.
Model	887.57	25.00	35.50	12.99	<.0001**
Norm	55.34	2.00	27.67	10.12	<.0001**
Color	52.73	2.00	26.36	9.64	0.0001**
Norm*Color	12.59	4.00	3.15	1.15	0.33
Prime	20.29	1.00	20.29	7.42	0.0065**
Norm*Prime	0.25	2.00	0.12	0.05	0.96
Color*Prime	6.94	2.00	3.47	1.27	0.28
Norm*Color*Prime	24.42	4.00	6.10	2.23	0.06
Exercise behavior	249.85	2.00	124.93	45.70	<.0001**
Street-view attractiveness	340.16	6.00	56.69	20.74	<.0001**
Residual	5352.27	1958.00	2.73		
Corrected Total	6239.84	1983.00	3.15		

Note: **p < .01, df: Degrees of freedom, SS: Sum of squares, MS: Mean square.

primed by sneakers. Second, color was significant ($\text{Mean}_{\text{nocolor}} = 7.81$; $\text{Mean}_{\text{red}} = 8.21$; $\text{Mean}_{\text{blue}} = 8.20$; $F = 9.64$, $p < .001$), implying participants are more interested in walking when the sidewalks are colored. However, no significant difference existed between red-colored and

each factor could play its part in boosting walking interest undisturbed by the other two. To demonstrate the effects of each factor on walking interest more precisely, a regression analysis was further conducted. **Table 3** reports the effects of color, norm, and priming on tourists' interest to walk. It is worth noting that as regressors of color, norm and priming are categorical variables, the coefficients must be interpreted as the differential effect with respect to that associated with the reference group (Pedhazur, 1991). Specifically, with respect to the uncolored-sidewalk reference group, a tourist seeing blue-colored sidewalks (red-colored sidewalks) is expected to increase her or his interest in walking by a sizeable 33% (32%), suggesting that tourists' interest in walking is highly sensitive to whether or not the sidewalks are colored. Similar effects (32% and 31%) are found if a tourist reads norms (identity-existent norm and identity-absent norm), compared with when no norm was displayed. If a tourist is primed with sneakers, her or his interest in walking is increased by approximate 20%. All coefficient differences from the reference groups are statistically significant (p -values < .01), suggesting that color, norm and priming are effective interventions in improving the interest of walking in tourists. The regression equation for tourists' interest in walking is further expressed as Equation (2) where value 1 is taken for a certain level of interventions if it occurs, otherwise value 0 is taken.

$$\begin{aligned} \text{Walking Interest} = & 5.1 + 0.2\text{Priming} + 0.33\text{BlueSidewalk} + 0.32\text{RedSidewalk} + 0.32\text{IdentityExistenNorm} \\ & + 0.31\text{IdentityAbsentNorm} + 0.28\text{StreetviewAttractiveness} + 0.21\text{ExerciseFrequency} \end{aligned} \quad (2)$$

blue-colored sidewalks. In other words, participants show the same walking interest in red-colored sidewalks as blue-colored sidewalks. Third, the main effect of descriptive social norms was significant ($\text{Mean}_{\text{no_norm}} = 7.87$; $\text{Mean}_{\text{IdentityExisten_norm}} = 8.16$; $\text{Mean}_{\text{IdentityAbsent_norm}} = 8.14$; $F = 10.12$, $p < .001$), implying participants become more interested in walking when they get to know most people are also walking. However, participants don't care whether the people are tourists or not, as no significant difference existed between the descriptive norm with identity information and descriptive norm without identity information. In sum, Hypotheses 1a, 8, and 9 were supported.

Based on the ANCOVA outputs in **Table 2**, no statistically significant interactions between the two-way effects (i.e., color x norm, color x priming, and priming x norm) or between the three-way effect (i.e., color x norm x priming) were found (p -values > .05), suggesting that

Table 3
Summary of Colors, Norms, and Priming on Walking interest.

Source	SS	df	MS	F-value	
Model	774.1424	7	110.592	39.98	
Residual	5465.694	1976	2.766		
Total	6239.837	1983	3.147		
Predictors	Coef	t-value	P-value		
Constant (Colors)	5.110	26.85	<.0001**		
Blue	0.325	3.55	<.0001**		
Red (Norms)	0.321	3.49	<.0001**		
Identity-existent	0.321	3.41	0.001**		
Identity-absent	0.315	3.38	0.001**		
Primed (Priming)	0.196	2.60	0.009**		
Exercise Frequency	0.211	10.31	<.0001**		
Streetview Attractiveness	0.282	9.78	<.0001**		
Adjusted R ²	0.121				

Note: **p < .01, df: Degrees of freedom, SS: Sum of squares, MS: Mean square.

4.3.2. Color on enjoyment, excitement and attention

Hypotheses 1b, 1c, and 1d, which predict the effect of colored sidewalks on perceived enjoyment, excitement, and attention, were tested by MANOVA followed by a series of one-way ANOVA. The results (**Table 4**) revealed that colored sidewalks had a significant main effect on enjoyment ($\text{Mean}_{\text{nocolor}} = 5.718$; $\text{Mean}_{\text{red}} = 5.975$; $\text{Mean}_{\text{blue}} = 5.969$; $F = 9.12$, $p < .001$), excitement ($\text{Mean}_{\text{nocolor}} = 5.422$; $\text{Mean}_{\text{red}} = 5.658$; $\text{Mean}_{\text{blue}} = 5.655$; $F = 7.04$, $p < .001$), and catching participants' attention ($\text{Mean}_{\text{nocolor}} = 5.833$; $\text{Mean}_{\text{red}} = 6.290$; $\text{Mean}_{\text{blue}} = 6.268$; $F = 41.50$, $p < .001$). Therefore, Hypotheses 1b - 1d were supported. These

Table 4
Descriptive information of colors on enjoyment, excitement and attention.

		Red	Blue	No color
Enjoyment	Mean	5.975	5.969	5.718
SD	0.044	0.047	0.054	
F				9.120
p-value				<.0001
Tukey's test				nocolor-blue** nocolor-red**
Excitement	Mean	5.658	5.655	5.422
SD	0.046	0.049	0.057	
F				7.040
p-value				0.001
Tukey's test				nocolor-blue** nocolor-red**
Attention	Mean	6.290	6.268	5.833
SD	0.038	0.037	0.044	
F				41.500
p-value				<.0001
Tukey's test				nocolor-blue** nocolor-red**

Table 5
Summary of Enjoyment, Excitement and Attention on Walking interest.

Source	SS	df	MS	F-value
Model	2469.791	3	823.264	432.37
Residual	3770.046	1980	1.904	
Total	6239.837	1953	3.147	
Predictors	Coef	t-value	P-value	VIF
Attention	0.226	7.16	<.0001**	1.14
Enjoyment	0.633	19.38	<.0001**	1.75
Excitement	0.226	7.31	<.0001**	1.72
Constant	1.700	8.21	<.0001**	
Adjusted R ²	0.3949			

Note: **p < .01, df: Degrees of freedom, SS: Sum of squares, MS: Mean square.

results imply that participants easily noticed colored sidewalks, and felt more excited and enjoyable when walking on colored sidewalks. However, no significant difference was found between red-colored sidewalks and blue-colored sidewalks in catching attention, and eliciting enjoyment and excitement, suggesting that red and blue sidewalks are equally noticeable and participants feel same enjoyable and exciting when imagining walking on either red- or blue-colored sidewalks.

4.3.3. Enjoyment, excitement and attention on walking interest

To test the relationship among enjoyment, excitement and attention against walking interest (**H2**, **H3**, **H4**), an ordinary linear regression was conducted. As shown in **Table 5**, attention ($\beta = 0.226$, $t = 7.16$, $p < .01$), enjoyment ($\beta = 0.633$, $t = 19.38$, $p < .01$), and excitement ($\beta = 0.226$, $t = 7.31$, $p < .01$) positively predicted walking interest, implying that participants become interested in walking when they are feeling enjoyable, excited or the sidewalks are able to catch their attention.

4.3.4. Mediation of enjoyment, excitement and attention

To test the mediating roles of enjoyment, excitement and attention, we used the sem command and medsem command in Stata (Mehmetoglu, 2018). Medsem command tests mediational hypotheses by using Baron and Kenny's (1986) approach that was modified by Jacobucci et al. (2007) as well as an alternative approach proposed by Zhao et al. (2010). After using the built-in sem command to estimate a mediation model, we ran medsem command as a post estimation for each hypothesized mediator. In mediation analysis, we reduced the color factor to be two levels — colored sidewalks and uncolored sidewalks, because no significant mean differences existed in walking interest, enjoyment, excitement, and attention across red- and blue-colored sidewalks in the previous results. For Hypothesis 5, enjoyment was the hypothesized

mediator, with the colored sidewalk as the independent variable and walking interest as the dependent variable. As shown in **Table 6**, results indicated a significant mediating effect of enjoyment on the relationship between colored sidewalks and walking interest ($z = 4.239$, $p < .001$). The mediation of enjoyment is partial, because color still has significant impact on walking interest, as shown in step 3, after enjoyment was added in the model. For Hypothesis 6, excitement was found to significantly mediate the relationship between colored sidewalk and walking interest ($z = 3.712$, $p < .001$), and the mediation was partial as well. As shown in **Table 6**, the results showed a significant mediating role of attention on the relationship between colored sidewalk and walking interest ($z = 7.798$, $p < .001$). The mediation effect of attention is complete, because color becomes statistically insignificant, as shown in step 3, after attention was added. Therefore, **H5**, **H6**, and **H7** were supported.

5. Discussion and conclusion

5.1. Main findings

Given tourism's innate mobility-promoting characteristic, travel can potentially be an effective mechanism for consumer well-being enhancement. The current study lends empirical evidences for how environmental cues can encourage city tourists to stay active. The current study has examined three design factors that work as nudges to encourage walking and has noted that they increase tourists' interest in walking when they visit a city. One of the key design factors being considered by this study is the use of color. Compared with bare sidewalks, red and blue sidewalks delighted and excited tourists, and attracted tourists' attention to walkways. In our study, the multifaceted effects of colored sidewalks notably increased tourists' interest in walking. A written message is another validated design factor in this study. A short message that describes the popularity of walking among other tourists increased our study subjects' interest in walking. Images of running shoes piqued tourists' walking interest as well. The results of this study suggest that the sneaker images primed tourists with the idea of walking. Once primed with the idea of walking, the subjects showed more interest in actually taking a walk. This research contributes to walkability design in city tourism research and bears practical implications.

5.2. Theoretical contributions

This study is timely as it aligns perfectly with the increasing call for an increased level of physical activity and a more active lifestyle as a

Table 6
Effect of colored sidewalks and excitement (enjoyment, attention) on walking interest.

	Step 1 (X → M)	z-value	Step 2 (M → Y)	z-value	Step 3 (X → Y)	z-value	Step 4 (Sobel Test z-value)	p-value
Color (X)	0.254	4.27**			0.175	2.58**	4.239**	<.0001
Enjoyment (M)			0.841	33.01**				
Color (X)	0.234	3.75**			0.234	3.19**	3.712**	<.0001
Excitement (M)			0.66	25.02**				
Color (X)	0.446	9.11**			0.143	1.76	7.798**	<.0001
Attention (M)			0.55	15.09**				

Note: **p < .01.

society. The current study is the first to apply nudges into the context of walkable city design oriented towards travelers. Nudges are behavioral influencers that drive behaviors by making small changes to the environment (Thaler & Sunstein, 2009). In particular, this study sheds lights on how nudge factors such as color and message or object (e.g. shoes) priming can be used as design elements to encourage consumers to be more physically active while on a trip. This result aligns with the proposition related to the intuitively automatic thinking system in the human brain (Evans & Frankish, 2009) where behavioral scientists build a choice architecture to nudge desirable behaviors to happen without performers' awareness and intentions. The application of the nudge theory has been used in tourism since it was first proposed more than a decade ago. Most such applications are in the context of green practices and food choice. A few examples include nudges for paying an aviation green tax (Kim & Hyun, 2021), to lower hotel electricity consumption (Chang, Huh, & Lee, 2016), to reduce the replacement of hotel towels (Goldstein, Cialdini, & Griskevicius, 2008), and to promote healthy eating (Bergeron, Doyon, Saulais, & Labrecque, 2019). The current study is novel in that it sheds light on the effects of three specific nudges - colored sidewalk, the use of message norms, and walking shoe-priming on tourists' physical wellness under the context of urban tourism. It broadens the application of nudge interventions into the city tourism scenario.

Nudge interventions are multifarious. One intervention is the perceptual salience that captures involuntary attention by objects' exogenous features (Itti & Koch, 2001). The current study is a pioneering effort in using color as a means to stimulate perceptual salience and thereby increasing travelers' desire for walking. This research noted the mediation effect of involuntary attention on the relationship between perceptual salience stimuli and walking interest. The study results show that the use of colored sidewalks under experimental conditions can lead to the activation of involuntary attention on the part of the visitors, which in turn could generate a sense of soft fascination with the area and desire to wander about. More research needs to be conducted in order to establish the potential conceptual relationship between perceptual salience, involuntary attention, the sense of fascination, and their effect on behavioral responses. Nonetheless, our research is a first step towards demonstrating these constructs can co-function to trigger an increase in tourists' interest in walking. It establishes a linkage between perceptual salience and the promotion of tourists' physical wellness.

This study is innovative in priming tourists with sneakers to promote interest in walking. The effectiveness of this priming intervention may be explained by how the use of walking shoes may influence tourists' implicit memory on performing unconscious behaviors. Although there has been research in tourism examining priming effect on destination marketing and green practices (e.g. Cowan & Spielmann, 2020; Tanford, Kim, & Kim, 2020; Moorhouse, D'Cruze, & Macdonald, 2017), the current study extended our understanding of priming effect on encouraging tourists to be physically active. Using sneakers as a primer to promote exercise is unique in that it is different from previous studies where participants were primed with stairs and exercise-related logos (Blumenthal-Barby & Burroughs, 2012; Iso-Ahola & Miller, 2016). It is recognized that not all priming interventions are effective. For instance, in earlier studies it was found priming participants with exercise-related logos was ineffective (Iso-Ahola & Miller, 2016). The current study brings attention to the selection of an effective primer. Do images with explicit meaning have a better priming effect than images with implicit meaning? Studies regarding the priming effect on exercise behaviors still

remain scarce. Future research should look at primer selections and shed lights on traits of effective primers in nudging physical activities.

The current study also extends the application of descriptive norms to tourist physical wellness enhancement. Descriptive norms can be effective in guiding behavior because it provides a standard of the majority as a reference point for people to conform their behavior to (Schultz et al., 2007). A few studies in the field of health research have uncovered the effect of descriptive norms on promoting healthy behavior, including healthy food choices (Thomas et al., 2017) and physical activity (Burger & Shelton, 2011; Priebe & Spink, 2012). The results of the current study align with previous studies in health research where descriptive norms are effective in nudging people to take stairs, use active transportation, and use fitness facilities (Priebe & Spink, 2012). The study provides additional evidence towards the importance of identifying appropriate reference groups when using norms as a behavioral nudge. In our study, the descriptive norm where identity information was added (i.e., the reference group is "tourists traveling in this city") is not shown to be more significantly effective, compared with the descriptive norm without identity information (i.e., the reference group is just "people") in improving tourists' interest in walking. The ineffectiveness of the descriptive norm with identity found here is possibly because participants weakly identified themselves with the identity group. In the study of Priebe and Spink (2012), the descriptive norm using "other university students" as the identity group shows no more effectiveness in nudging university students to exercise, whereas the descriptive norm using "your co-workers" as the identity group was shown to be significantly more effective in nudging office workers to exercise. As their research explained, an office is a more self-contained setting than a university, which makes office workers identify more strongly with their identity group (i.e., their co-workers) than students identified with their identity group (i.e., other university students). In the same vein, an earlier study also suggested the setting identity being an important element in improving a descriptive norm's impacts (Goldstein et al., 2008). In their study, a provincial norm (i.e., descriptive norms with a setting identity that closely matches individuals' immediate situational circumstances, such as "the majority of guests in this room reuse their towels") was shown to be significantly more effective than the global norm (i.e., descriptive norm without current situational identity, such as "the majority of guests reuse their towels") in improving towel reuse. However, although our study specified the setting identity in the descriptive norm (i.e., "tourists who are traveling in this city"), the current study didn't directly assess if participants identify themselves strongly with the identity group, making it unclear if providing descriptive norm with identity information is more effective than a global descriptive norm under the nudging-to-walk context. Future research is required.

The current study also provides insights for research on wayfinding at a destination. Wayfinding was formally defined by Lynch (1964) as the consistent use and organization of sensory cues from the external environment. It's the process of finding an individual's way to a destination in a familiar or unfamiliar setting using any external environmental cues. In other words, for tourists, wayfinding at a destination is the process of finding their way to an attraction by using given environment cues. When cues given by the destination do not adequately demonstrate orientation, it leads to stress, frustration and time wasted, whereas a well-designed wayfinding system encourages comprehension of the destination, assists tourists to find their way, maintains a sense of security and adds depth and intensity to tourist experience (Arthur &

(Passini, 1992; Lynch, 1964). It's worth noting that wayfinding has been divided into three types, namely recreational, resolute and emergency (Fewings 2001). Recreational wayfinding allows the opportunity to solve spatial orientation problems meanwhile being a source of enjoyment. Compared to resolute wayfinding where the main purpose is to find one's way in the most efficient manner, time is not an issue for recreational wayfinding. The current study suggests colored sidewalks be incorporated into wayfinding signage designs at destinations. A destination can connect tourist attractions with eye-catching colored trails, guiding tourists enjoyably and confidently to go to different attractions in an unfamiliar environment. The role of colored sidewalks in wayfinding at a destination deserves further research.

This study sheds light on walking in tourism. The existing literature on walking largely pertains to two conceptual scenarios, recreational walking and transport walking. Transport walking refers to walking specifically to get from point A to point B, such as walking to a shop or public transport. Research on transport walking suggests urban planners should try to increase residential density, street connectivity, mixed land-use, and proximity to destinations (Giles-Corti et al., 2013). On another hand, research on recreational walking found recreational walking is undertaken because of recreation, health, or fitness purposes, and suggests nudging such a walking behavior needs to focus on improving the neighborhood attractiveness (Owen, Humpel, Leslie, Bauman, & Sallis, 2004; Sugiyama, Francis, Middleton, Owen, & Giles-Corti, 2010). Some researchers suggest recreational and touristic walking are interlinked because they share a desire on the part of the users to escape from urban life routines (Witte, 2021). Others suggest that apart from motivational drives of relaxation and exercise as residents do in a recreational walking, tourists also walk for exploring the environment and achieving other tourism-oriented aims such as adventure (Davies, 2018). Future studies need to further investigate the motivations of tourists in walking, and factor tourism-oriented walking aims and attributes into walkable design for tourists.

5.3. Practical implications

Against the background that cities are increasingly paying attention to such design factors as place walkability, this research bears a number of practical implications. The results shed light on possible mechanisms that may assist destinations to better serve the well-being needs of the travelers. Our study suggests several effective ways to nudge city tourists to walk.

Our research shows that colored sidewalks improve tourists' interest in walking. This finding suggests that color can be incorporated in the design of walkable routes in cities. Indeed, we speculate that the use of color may contribute in at least three ways. First, colors influence people's emotions. Compared with walkways in achromatic colors that blends into the background, this research suggests that colored walkways have great potential to improve pedestrians' moods. Urban planners can incorporate colors into walkway design to elevate pedestrians' moods and build a happy city. Second, colored sidewalks catch attention which, in turn, encourages people to take a walk. We recognize that the experiment utilized a simplistic representation of reality, and that these findings must be taken in context. In real life, the city including colors is much more dynamic. As to what color makes a better contrast and are more eye-catching under such dynamics, further research is needed. The third consideration of colored walking trails is the use of color for city navigability for its visitors and for improving a visitor wander-about

experience. This practice could provide tourists with a visual orientation, reduce their cognitive burden in finding the right routes, and offers a visitor a sense of security. Tourism practitioners can strategically utilize colored trails to orient visitors and potentially thread together sights and sounds of what a city can offer. In fact, there are examples of such applications in practice. For instance, Boston city has a freedom trail. The trail is a 2.5-mile red-brick route and connects 16 significant historic sites. The red bricks guide tourists to explore the major attractions in Boston.

Our study attested that priming with sneaker photos improve tourists' interest in walking. This finding implies that sneakers or other objects that cue tourists with the idea of walking can be potentially used as a cue to increase travelers' likelihood to walk. Street arts such as graffiti arts and sculptures can potentially incorporate such nudge elements. For one thing, sneaker artworks decorate the city as other artworks do. Hypothetically, hotels could employ a similar nudge strategy (e.g. paintings) near elevators or in guest rooms. Utilizing norms with other design features may also lead to greater activity. For instance, hotels can employ a similar nudge strategy to encourage its guests to be more physically active by taking on opportunities to walk. When guests see that most fellow guests use stairs instead of elevators, for example, they may be encouraged to take the stairs as well. More broadly, our study also shows descriptive norms can be used to increase tourists' walking interest.

Worth noting is that we do not intend to be overly prescriptive in our discussion of practical implications, as other factors such as brand considerations, cultural traditions and norms will need to be factored for businesses and cities to take on nudging strategies to encourage visitors to be physically active.

6. Limitations and future research

This study utilizes an experimental design to understand the effectiveness of possible interventions to influence the behavior, or nudges, the behavior of travelers. As such, the authors recognize that the experimental design is a simplified version of the conditions travelers face and the study also relies on the reported behavioral intentions of the participants.

The examination of the impact of color on sidewalks in a streetscape utilized a simplified representation of the streetscape in the experiment with colorless buildings and other surroundings in the city scenario. Obviously, in real life, existing street-view buildings are not all colorless, and the city including colors is much more dynamic. In this sense, there are lots of complications that's not being studied in our research. Future studies need to subject the research in a real-world scenario, in terms of to better understand the applicability of colored sidewalks in real-world dynamic environments.

Our study also indicates that both red and blue are pleasant colors in a walkable design, and both are likely to improve tourists' walking interest. Although our study didn't identify different impacts brought by different colors, future studies are needed. This follows because the existing literature shows that warm colors have strong excitation potential and generate powerful actions, whereas cool colors encourage a restful state and produce calm and stable actions (Bellizzi & Hite, 1992; Elliot, Maier, Moller, Friedman, & Meinhardt, 2007; Goldstein, 1942). For instance, for warm colors, yellow is perceived to be cheerful because it is the color of the sun and is associated with laughter, happiness, and optimism. When surrounded by yellow, a person feels optimistic because

of more serotonin (a feel-good chemical) released in the brain (Cerrato, 2012). Orange combines the physical energy of red with the cheerfulness of yellow, thus inspiring rejuvenation and exhilaration (Cerrato, 2012). Those studies indicate that some colors may work better than others in the role of stimulating human emotions and desires. Therefore, further research needs to investigate whether all colors are the same or there may be difference in color effects on walkability.

Also, it is possible that navy blue works differently from light blue in inducing emotions for walkability. Existing literature in color psychology found that people's emotional response to a particular color (a hue) varies depending on the saturation and lightness of the color (Wilms & Oberfeld, 2018). The more saturated and brighter a color, the higher emotionally arousal the color seems to induce (Wilms & Oberfeld, 2018). Interaction effects of these three dimensions of color (saturation, lightness, and hue) also seem to exist (Wilms & Oberfeld, 2018). Future studies need to better understand those nuances, including specific saturation and lightness of color choices in influencing emotions.

The application of color in walkways should also reflect the cultural norms in a city. Existing literature suggests that colors have affective meanings, and a same color may deliver different affective meanings under different cultural contexts (Aslam, 2006). For example, the connotation of red in some western cultures has the meaning for fear and anger, while in some eastern cultures, red means love and happiness (Aslam, 2006). In other words, in a city where red represents negative meanings, will people react negatively to a red-colored sidewalk? Will people be more willing to take a walk on a red-colored sidewalk when red carries positive connotations in their culture? Future research needs to really investigate the implications of meanings of colors for potential varieties of people's perceptions and behaviors associated with colored walkways.

In addition, a city may have a personality. A color used for walkways should align with the personality of the city. Since blue seems to be a symbol of peacefulness and restfulness, does blue on sidewalks diminish the image of the city if it projects itself as being full of vigor? If a city wants to brand itself as being full of vigor, as red seems to symbolize energy, will red-colored walkways work better than blue walkways? Future research is needed to better understand the implications of colored trails on a city's branding.

It should be noted that in addition to the limitations of the experimental design, the study relies on self-reported behavioral intentions. Although theories of attitude-behavior relations (e.g., the theory of planned behavior) and models of health behavior (e.g., the protection motivation theory) converge on the idea that desire is the key determinant of behavior, studies show that changing desires does not guarantee behavior change (Ajzen et al., 1991; Fife-Schaw, Sheeran, & Norman, 2007; Webb & Sheeran, 2006). Because of this gap between desire and behavior, we suggest future studies conduct experiments in practice. That is, how often a sidewalk is used in real life before and after it gets painted.

Future research may also assess if nudges for tourist walking have a long-term impact on tourists' wellbeing. For example, will the increased walking interest in tourists continue into their daily lives? After tourists come back to their usual environment, will the walking behavior under the tourism scenarios encourage walking behavior in daily scenarios? Also, how long will the effectiveness of the three nudges in this study last under a tourism scenario? Moreover, nudges may show different

effectiveness in a tourist's hometown environment and the destination environment. It's possible that tourists diminish their responses to the frequently repeated colored sidewalks and priming effects, due to their habituation of their hometown (Rankin et al., 2009; Rieth & Huber, 2010). Tourists' familiarity to their hometown environment is also likely to decrease their need in wayfinding provided by colored sidewalks. In other words, the effects of colored sidewalks and priming may perform better in a destination environment than in a hometown environment. On the contrary, the effects of social norms may become stronger in a hometown destination. As people are more inclined to compare themselves to others when others are physically or psychologically closer, tourists are more likely to compare their walking behavior to their neighbors and thereby following the social norms that describe the behavior of their neighbors in their hometown (Bergquist & Nilsson, 2018). These various research questions are worthy of further investigations.

It's also worth noting that to make it optimal, the strategy of nudges is supposed to involve more than just practitioners in the hospitality and tourism sector. The local government can play a complementary role in nudging visitors to walk. For example, the government may offer incentives for and award best walkable designs for multi-purpose use. Future studies can further examine the stakeholders of nudging strategies and how they play a synergistic role in the implementation of a nudge strategy for tourists.

Each author's contribution

Jun planned and carried out the experiments. Jun drafted the initial manuscript. Jun and Xinran conceived of the presented idea. Xinran contributed to the design of the research and took charge of overall direction. Mark guided the analytical methods and Jun, Xinran and Mark participated in the research manuscript writing and revisions. Jonathon commented and worked on the manuscript. All authors provided critical feedback and helped shape the research, analysis and manuscript.

Impact statement

This study is a pioneering effort in using color as a means to stimulate perceptual salience and individuals' moods, and thereby increasing travelers' desire for walking.

This study notes the mediation effect of involuntary attention and emotions on the relationship between color and walking interest. This finding suggests that color can be incorporated in the design of walkable routes for city tourists.

This study is innovative in priming tourists with sneakers to promote interest in walking. Using sneakers as a primer to promote exercise is unique.

This study also extends the application of descriptive norms to tourist physical wellness enhancement. It provides an additional evidence towards the importance of identifying appropriate reference groups when using norms as a behavioral nudge.

This study aligns perfectly with the call for an increased level of physical activity as a society. It is the first to apply nudges into the context of walkable city design oriented towards travelers.

Experimental Procedure Example

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.



2.



The walking shoes above is appealing.



3.

**The walking shoes above is appealing.**

	-3	-2	-1	0	1	2	3	
disagree	<input type="radio"/>	agree						

4.

**The walking shoes above is appealing.**

	-3	-2	-1	0	1	2	3	
disagree	<input type="radio"/>	agree						

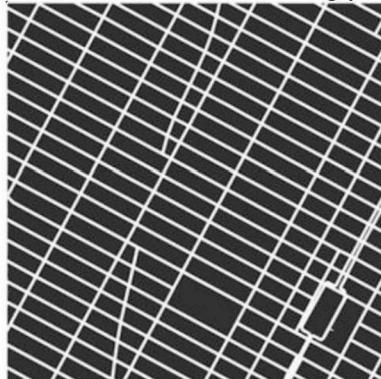
Main Scenario

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, 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.

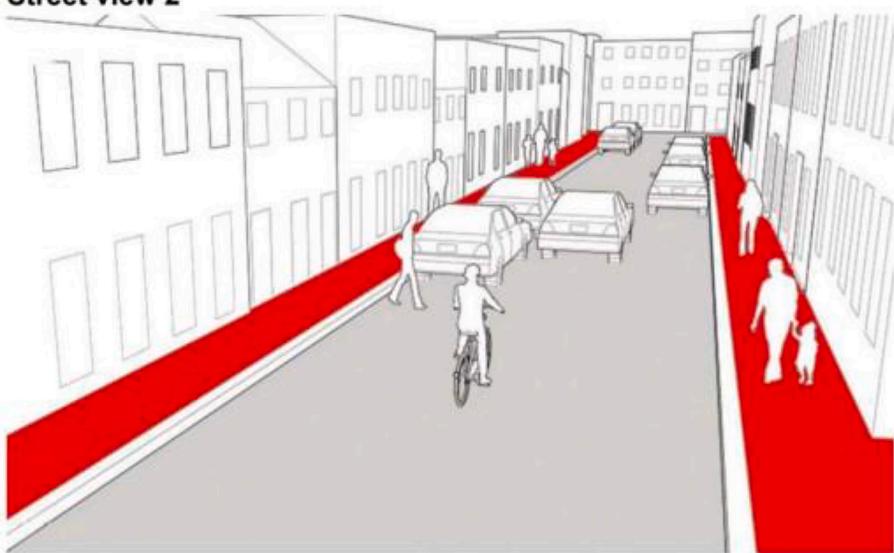
You have all the needed navigation tools, including electronic maps and paper maps.

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

Street view 1



Street view 2



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.

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