Perceived legibility in relation to path choice of commuters in central business district

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Abstract Commuters are the major group of pedestrians who walk for daily transportation along the short pathways between the metro stations and their workplaces in the central business district (CBD) of Kuala Lumpur. Shorter walking times and shorter distances are significant criteria in commuter path choice; however, in the presence of multiple pathways of virtually the same length, the criteria of perceived time and perceived distance play the key role in path choice. In this regard, this study investigates perceived legibility (PL) as an alternative path choice criterion for commuters on the basis of its hypothesized correlation with perceived time. For commuters, a more legible pathway is a well-signed directional pathway, which generates a strong sense of direction toward the destinations along it. As Perceived legibility (PL) is assumed to be a positive factor for commuters’ choice of path, the main question of this research is whether the highest PL is taken into account by commuters as an important path choice criterion in the case of available alternative pathways of almost the same length. In this regard, the importance of the highest PL for commuters’ path choice was examined in comparison with other probable path choice criteria. In addition, the components of the highest PL were explored according to the perceptions of commuters. It was conducted in nine zones of the CBD of Kuala Lumpur. The zones were selected and finalized based on the design of the zone selection process. The collected data were processed using two consecutive survey questionnaires and an observational analysis. The highest PL showed moderate importance regarding commuter path choice. However, because of the significant correlation between PL and perceived time as well as sense of pleasance as two of the most important path choice criteria, highest PL or strongest sense of direction toward the destination is taken into account as one of the key factors for commuter path choice. Furthermore, factors such as the presence of buildings according to their height and façade, and commuters’ greater ability to see their destination point while walking, were found to be components of PL. Such relationships indicate the importance of these physical and visual factors for improving the path choice and walking rates of commuters in the CBD.

Introduction Walking is an activity that almost everyone is involved in it. It provides many advantages for both individuals and the society (Gehl, 1987). The relationship between walking behavior and the built environment has been the subject of a growing number of studies (Frank and Pivo, 1995; Greenwald and Boarnet, 2000; Ball et al., 2001; Black et al., 2001; Handy and Clifton, 2001; Corti and Donovan, 2002). Indeed, these studies have provided an evidence for a correlation between the built environment and walking.

According to Alfonzo (2005), environmental factors, ranked by the extent of their contribution to walking behavior from the greatest to the least, include: feasibility, accessibility, safety, comfort and pleasance. In another categorization by Southworth (2005), these environmental factors also include connectivity, linkage with other modes,
fine grained land use patterns, safety, quality of the path and path context. Several aspects were found to be related to path context, such as visual interest, visibility of landmarks along the pathways, the view of public gardens, design of the street, transparency of fronting structures, visible activity, street trees and lighting (Lynch, 1980; Southworth, 2005). However, according to Zacharias (2001), the design properties of the pedestrians’ environment are widely replicated, but there is little knowledge about how users respond perceptually and behaviorally to these features. Indeed, research in walkability lacks qualitative studies that address the relationships between the perceived environmental factors and walking in micro scale environments, such as main streets (Mehta, 2008). In addition, the studies on walking behavior found that the effects of environmental factors on walking behavior depend on the purpose of the trip, whether it be walking for recreation or to reach a destination. Because most people walk as a form of daily transportation, the importance of considering the contribution of environmental factors to walking for daily transport has been highlighted in studies on walking behavior (Craig et al., 2002; Crein et al., 2007).

Commutes are the main group of people who walk as a means of transportation, especially along the short pathways of the CBD between metro stations and workplaces. These areas provide a suitable context for micro scale analysis of the relationships between environmental factors and the walking behavior of commuters. On average, 120,000 commuters pass daily through Kuala Lumpur’s CBD (Draft Structure Plan Kuala Lumpur, 2002, 2003). According to Guo (2009), analyzing pedestrian path choice constitutes an appropriate method by which to explore the effects of environmental factors on commuter walking behavior if the context contains multiple walkable pathways between different urban points. Typically, commuters have a choice of several pathways between stations and workplaces they can take to reach their destinations in the CBD (Paydar, 2013).

In addition, a considerable numbers of studies on pedestrian behavioral models in micro scale urban settings – at the scale of the local streets – consider path choice behavior as part of the process of exploring pedestrian behavior (Hoogendoorn, 2004; Hoogendoorn and Bovy, 2004; Kitazawa and Batty, 2004). Route or itinerary choice models concern the pedestrians’ decision-making process owing to the optimal path between an origin and either a fixed, or an undefined destination among a number of alternatives (Papadimitriou et al., 2009). Utility maximization theory is most frequently used in these studies (Hoogendoorn, 2004; Hoogendoorn and Bovy, 2004; Kitazawa and Batty, 2004). Here, the main behavioral assumption is that all of the pedestrians’ actions – whether performing an activity or walking along a certain route – will provide them some utility. Furthermore, the pedestrian predicts and optimizes this expected utility. Therefore, according to this theory, pedestrians choose the alternatives that provide them the maximum utility. The environmental factors involved in these pedestrian’s path choice behavioral models as the utility or disutility, are derived from the results of related empirical studies on the path choice criteria of pedestrians (Hoogendoorn and Bovy, 2004).

Factors Affecting the Path Choice of Pedestrians and Commuters

While most pedestrians tend to choose the shortest route, they are seldom aware that they are using the minimization of distance and time as a first strategy in their route choice (Seneviratne and Morrall, 1985; Golledge, 1995; Ovstedal and Ryeng, 2002; Kitazawa and Batty, 2004; Agrawal et al., 2008). However, this is not necessarily the only factor that affects pedestrians’ choice of path (Marchand, 1974; McFadden, 2000; Foltete and Piombini, 2007, 2010). Additional factors include the number of obstacles or interactions with other pedestrians along the route, the directness of the route that are the number of directional changes, the overall attractiveness of the environment, pleasant, habit, the number of crossings, levels of noise pollution, safety from motor vehicles, levels of weather protection and the presence of shops (Hill, 1982; Seneviratne and Morrall, 1985; Bovy and Stern, 1990; Hoogendoorn and Bovy, 2004; Agrawal et al., 2008). However, most of these studies argue that time and distance are definitely the most important criteria in pedestrian path choice (Figure 1).

Isaacs (1998), has also argued about the importance of a sense of comfort for path preference of pedestrians in their daily transport. According to Alfonzo (2005), comfort refers to the people’s level of ease, convenience and contentment. The environmental factors that contribute to a sense of comfort along pathways have been investigated by previous research. According to Ovstedal and Ryeng (2002), ease of movement is the main...
indicator of one’s sense of comfort along the pathways. Overall, the qualities that may affect comfort levels, include the urban form features that affect the relationship between pedestrians and motorized traffic (for example, traffic calming features, speed limits, the width and length of streets and the presence of buffers), the condition of the pedestrian walkway system (for example, sidewalk widths and sidewalk maintenance), urban design elements intended to offer protection from unfavorable or extreme weather conditions (for example, canopies and arcades), and features that provide amenities throughout a setting (for example, street benches, drinking fountains and other street furniture (Alfonzo, 2005). On the other hand, a sense of comfort is one of the perceptual qualities, which reflects self-assessment of the pedestrians from all of these comfort-related components along the pathways; it has been found to be one of the important factors that contributes to walking behavior, especially when walking for transport reasons (Handy and Clifton, 2001; Ewing and Handy, 2009). Furthermore, previous studies on the path choice behavior of the pedestrians have shown the importance of the concept of ‘pedestrian comfort’ as one of the important path choice criteria of pedestrians (Helbing et al, 1997; Helbing et al, 2001). Therefore, the most comfortable pathway is considered to be one of the path choice criteria of the commuters in this research (Figure 1).

Generally, the esthetic attributes of a place are counted as secondary path choice criteria for pedestrians and for commuters, in particular (Seneviratne and Morrall, 1985; Golledge, 1995; Agrawal et al, 2008). According to Golledge (1999), esthetic attributes are regarded as a probable affective factor on commuter path choice, especially when commuters are approaching the stations on their return or evening trips. According to Isaacs (1998), a sense of pleasance is associated with the esthetic experience along the walkways. He found that pleasance, as one of the esthetic affective responses, is an essential factor in the path preference of pedestrians in their daily movements. Therefore, the effect of the most pleasant pathway is highlighted in the path choice of commuters, and especially in their return trips to the stations in the evening (Paydar, 2013) (Figure 1).

It should be noted that pedestrians, such as commuters who have the high familiarity with the context, would likely use their habitual pathway in daily movements (Golledge, 1999). Yet, even this habitual pathway is selected according to certain primitive path choice criteria. In other words, many of the aforementioned path choice criteria contribute to the commuters’ initial knowledge of the context that is involved in the selection of their pathway, and this selected pathway is later called the ‘habitual pathway’. Therefore, there is no conflict between habit and the role of the aforementioned factors in the path choice of commuters. The hierarchy of commuters’ path choice criteria in the CBD, based on the literature review, is shown in Figure 1 (Paydar, 2013). Furthermore, the extent to which the external factors play a substantial role in path choice behavior depends on the purpose of the trip, whether it be walking as a means of transportation or walking for recreation (Bovy and Stern, 1990; Hoogendoorn and Bovy, 2005), the type of destination (Golledge, 1999), the rate of familiarity (Bovy and Stern, 1990), age – based on three categories of children, adult, elderly, and gender (Hoogendoorn, 2001). Workplaces are the major destinations of commuters in CBD.
Commuters are adults and the majority of them have a high familiarity with the context. Therefore, studying the commuter’s behavior, the effects of familiarity, the purpose of the trip, destination, and age can be ignored, and only the contribution of gender to the relationship between external factors and commuter path choice need be examined (Figure 1).

A Particular Situation Occurring in the CBD

In an urban context, especially in areas with grid patterns, there are usually several instances of parallel pathways of the same length connecting one location to another (Agrawal et al., 2008). This situation frequently presents itself in commuter path choice as pedestrians make their daily walking trips between metro stations and workplaces in the CBD. None of the studies on pedestrian path choice has focused on such situations in an urban setting (Paydar, 2013). In this situation, the question that arises is this: What path choice criteria, other than shorter time and distance, are used by commuters in the presence of available alternative pathways with virtually the same length for commuters.

From a more comprehensive point of view regarding this directional quality, and through considering the environmental qualities of the pathways, the legibility of the path is an environmental variable that not only prevents pedestrians from getting lost but also assists in conducting them toward their destinations (Weisman, 1981; Grant and Herbes, 2007). As defined by Lynch (1960), the legibility of the pathway is the ease by which its parts can be recognized as a coherent pattern. Reviewing the literature on way-finding behavior of pedestrians, legibility is one of the main indicators of the environment which leads to better way-finding performance (Weisman, 1981; O’Neill, 1991). Therefore, Weisman stated that the higher legibility contributes to easier organization of one’s mental map of the environmental surroundings, which in turn leads to a better way-finding performance, especially for pedestrians who are trying to reach a novel destination. Indeed, legibility of the pathway depends on the familiarity of the users with the context (Weisman, 1981).

Golledge (1995), who examined the criteria of pedestrian path choice between a determined origin and a destination point, found that few of the respondents who took a particular pathway from origin to destination point chose the same pathway in the reverse direction. This difference in path choice depends on the direction of the trip. Golledge suggested an interpretation of this path choice behavior in which the respondents selected a route that took them away from the origin point as soon as possible and led them to their destination point as quickly as possible when approaching their destination. Indeed, he found that a directional quality, which is also progressive, affected the path choice of the respondents.

At first glance, this quality of the pathway could be related to the sense of progression, mentioned by Lynch (1960) as one of the essential qualities of urban pathways. According to Lynch (1960) and Paydar and Ramezani (2010), the sense of progression is explained through a perception of the path as an object going toward something. The path supports this perceptually so that it provides a sense of progression, while the opposite directions could be different.

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However, the legibility of the pathway for pedestrians who are familiar with the context is considered a directional quality. In this research, the perception of well-directed pathway toward the destination is referred to as PL and for the commuters who usually have a high familiarity with the context is defined in terms of the degree to which the pathway provides a stronger sense of the direction toward the destination (Paydar and Ismail, 2012).

In other words, a more legible pathway to the commuters is a well-signed directional pathway that generates a stronger sense of direction toward the destinations along it (Paydar, 2013). On the basis of this definition, PL is considered a positive factor for the commuters’ path choice. Therefore, it is expected to identify the contribution of the highest PL – which means the strongest sense of direction toward the destination – to the path choice.

It should be noted that the sense of direction toward the destination used in this research is different from a sense of direction which is treated only as a personal trait that has or lacks a sense of orientation (Kozlowski and Bryant, 1977; Prestopnik and Ewoldsen, 2000). Higher PL or a stronger sense of direction leads to well-directed pathway toward the destination. Therefore, PL depends on both urban settings and commuters’ spatial abilities. Elements of a well-directed pathway in the pathways of familiar environments have been investigated in previous research (Allen, 1997; Denis, 1997). Examples of these elements are longer path segments, landmarks at potential choice points and numbers of turns along the pathways (Lovelace et al, 1999). In these studies, the quality of route directions was measured subjectively (perceptually) by researchers; the correlation analysis between this subjective rating and the number of reported descriptive elements along the pathways mentioned by respondents identified the elements of the good directional pathways. These studies lack the subjective measurement of well-directed pathways based specifically on the perceptions of respondents. Exploring the elements of good directional pathways also needs a qualitative approach directly based on respondents’ perceptions. This qualitative approach may identify new elements in the well-directed pathway.

Therefore, the highest PL or strongest sense of direction toward the destination is potentially an important factor for commuters’ path choices. There is also another important aspect of

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**Figure 2:** The sequence of the study areas and the presented scenarios in the case of the availability of alternative pathways with almost the same length for commuters.
considering the highest PL as a path choice criterion of commuters: theoretically, there is a relationship between PL and perceived time.

According to the first scenario described previously (Figure 2), perceived time is expected to be the most important factor for commuters’ path choice in the case of alternative pathways of almost the same length being available. By having more directional cues, the pathway that provides a stronger sense of direction and leads to a well-directed pathway toward the destination, allows the walker to process the information related to retrieving the time more easily and more tangibly. On the basis of the storage-size hypothesis, easier information processing of such a pathway contributes to a shorter estimated time and distance compared with those pathways that provide a weaker sense of direction toward the destination.

Furthermore, it was also explained that a sense of pleasure is one of the esthetic affective responses along the pathways (Isaacs, 1998); potentially, this could be an important factor for commuters’ path choices. On the other hand, the presence of landmarks – including the visual focal points and orientation aids – is known as a component which contributes to intensifying the esthetic experiences of pathways (Isaacs, 2000). The presence of landmarks or the sense of direction could also be components of PL, according to previous research (Lovelace et al, 1999). Accordingly, it is assumed that there is a relationship between PL and a sense of pleasure from walking along the pathways. As the most pleasant pathway was introduced as one of the possible path choice criteria of commuters (Figure 1), such hypothesized relationships suggest another important aspect of the highest PL regarding path choices.

Therefore, the higher PL or stronger sense of direction toward a destination may show a direct contribution to commuters’ path choices as well as being an indirect contribution to interrelationships with other potentially important path choice criteria, including least perceived time and most pleasant pathway. In other words, the importance of the highest PL for path choice is highlighted more strongly when the interrelationships between highest PL and these probable path choice criteria of commuters are examined. These possible interrelationships are shown in Figure 3 (Paydar, 2013). Figure 4 presents the different possibilities regarding the contribution of PL to the path choice of commuters in the situations where there are several alternative pathways of almost the same length between station points and workplaces. According to the first and second possibilities presented in Figure 4, the importance of highest PL for commuter path choice in the CBD becomes apparent and is analyzed in those situations where there are several alternative pathways of almost the same length between station points and workplaces (Paydar, 2013).
Research Questions, Objectives and Hypotheses

Research questions

The research questions of this research are as follows:

1. Is the highest PL taken into account as the important path choice criterion of commuters in the case of the availability of alternative pathways with almost the same length?
2. What do commuters perceive as the components of highest PL along the pathways?

Research objectives

This study comprises of four objectives. The first objective of this study is to evaluate the importance the highest PL has on path choice among the other probable criteria of commuter path choice. Examining this objective will lead to identifying which of the aforementioned scenarios corresponds with the path choice criteria of commuters in this context. Furthermore, this research hypothesizes the possible relationships between highest PL and the aforementioned scenarios – meaning the path choice criteria, including the least perceived time and the most pleasant pathway – based on theoretical and empirical evidence. Accordingly, the second objective is to examine the indirect ways in which the PL would contribute to commuter path choice. These indirect ways are ascertained through an examination of the correlations between the highest PL and their assumed path choice criteria, consisting of the least perceived time and the most pleasant pathway. It must be noted that these PL-related path choice criteria are of more importance as path choice criteria than the highest PL. Otherwise, the indirect methods of contribution of the highest PL to path choice would not make sense.

The third objective is to explore the components of perceived legibility based on commuters’ perceptions. In fact, the second question of this research is answered. Several physical factors along the pathways are expected to be identified as components of the highest PL according to commuters. A qualitative approach will be adopted to explore this objective.

Finding the correlation between the physical factors and the perceptual qualities of the pathways is a main approach in contemporary urban design (Ewing and Handy, 2009; Paydar, 2013). Kwon (2007) has attempted to find the correlation between perceptions of legibility as well as complexity with certain configurational factors of pathways. Accordingly, this study not only intends to explore the components of PL, based on a qualitative approach (the third objective), but also aims to find out which of the components of PL has a significant correlation with its rate of occurrence along the pathways (fourth objective). In this regard, the components of PL are expected to be the physical factors that are measured along the traversed commuter pathways. In fact, in the fourth objective, PL is statistically assessed based on its components (physical factors) along the pathway.

Research hypotheses

The first hypothesis of this research arises in regards to the first objective. It has been shown that, on average, males perform better than females in way-finding tasks (Voyer et al, 1995).
According to Castelli et al (2008), the performance of the male subjects was significantly better than that of females in all the tests designed to investigate spatial abilities. In addition, examining the difference in way-finding strategies based on gender, Lawton (1994) found that women – besides reporting higher levels of spatial anxiety in their navigation – attended more to the instructions along the route on how to get from place to place, whereas men relied more on their sense of their own position in relation to environmentally referenced points for their navigation. Therefore, the effects of gender on the contribution PL makes to path choice are to be explored as well. Consequently, the following hypothesis is proposed at this step.

**Hypothesis 1**: The importance of the highest PL for path choice varies according to gender.

The second and third hypotheses of this research are based on the second objective. Accordingly, the following hypotheses are posited:

**Hypothesis 2**: Highest PL contributes to commuter path choice via the correlation with perceived time.

**Hypothesis 3**: Highest PL contributes to commuter path choice via the correlation with the rate of pleasance along the pathways.

The research framework of this study is shown in Figure 5.

![Figure 5: The research framework.](image)

*Notes: *These indirect ways are defined through the hypothesized correlations between the PL and the assumed related path choice criteria of commuters according to the reviewed literature.

The Study Area and Research Methodology

The CBD of a city is usually typified by a concentration of retail and office buildings. The CBD of Kuala Lumpur is compatible with the zone of the city center (Figure 6). The city center is the focus of local, national and international attention, and for many people it defines the image of Kuala Lumpur. This zone consists of the most important commercial locations in Kuala Lumpur, accounting for 25.2 per cent of its total commercial land use (Draft Structure Plan Kuala Lumpur 2020, 2003). The major components of the commercial floor space in Kuala Lumpur are offices, shopping centers, hotels and service apartments, and other services. Figure 6, also shows the distribution of the office buildings in the city of Kuala Lumpur. On average, 120 000 commuters daily, or 43 million annually, pass through Kuala Lumpur’s city center (Draft Structure Plan Kuala Lumpur 2020, 2003). The city center or CBD of Kuala Lumpur, identified with respect to the urban character of its area, is shown in Figure 6.

In conducting this study, it was mandatory to design a procedure that included representative zones between stations and major commuter workplaces in different areas of Kuala Lumpur’s CBD (Figure 8) (Paydar, 2013). Therefore, a zone selection process was designed and implemented. Selection of these zones as the representative zones of the CBD are in accord with the key questions, purposes and objectives of this study. Zone selection process consisted of two steps including map study and observational analysis. Each zone has three main components; the metro station, the workplace of commuters and the alternative pathways between the origin and the destination points of commuters, which are usually used by commuters in that zone. One of the necessary characteristics of these zones is that the length of the parallel pathways between stations and commuter workplaces within all the selected zones should be nearly the same. The former characteristic is to provide the possibility of compiling and comparing the data collected from the final selected zones. The average length of the inclusive pathways in the study zones is 450–500 m. Commuting pedestrians walk at the speed of 1.49 m/s on average (Hoogendoorn and Bovy, 2005). Therefore, the average time dedicated to the pathways in all selected zones is about 5 min, which allows the researchers to compare the estimated times of the pathways in all selected zones (Paydar, 2013). Finally, on the basis of the zone selection process, nine zones were designated as the representative CBD zones to be studied in this research.
These zones are located in the areas of Masjid Jamek (Three zones), Bukit Bintang (Three zones), Pudu (One zone) and Chow Kit (Two zones). The data used in this study were collected within these selected zones. Figure 7 shows the locations of the selected zones in the city center or CBD as well as some pictures from the pathways of each zone.

Steps were designed to examine each of the objectives (Paydar, 2013). The collected data were processed using two consecutive survey questionnaires and an observational analysis (Figure 8). The first survey was used in order to explore the components of highest PL along the traversed pathways of the commuters (the third objective). The respondents in the first survey were selected based on their tendency to cooperate in the specific workplaces of each zone. The prerequisites of selection of commuters was their walking experience between stations and workplaces in each zone and their familiarity with the context. In the first survey questionnaire, which was a sort of mixed interview-questionnaire, the respondents were asked to identify their usual pathway to reach the metro stations in their evening walking trips on the map. They were then asked whether the selected pathway would give them a strong sense of direction toward the metro station and, if they answered positively, the components of a strong sense of direction or higher PL were explored in an open-ended question. The researcher was available to the respondents to explain the question if needed. Content analysis was used to analyze the open-ended question. The least number of respondents required in the first survey was 50 commuters based on the requirements of implementing the content analysis (Baek et al., 2011). Therefore, 54 commuters in total including 6 respondents in each zone were considered the target group of the first survey.

In the second survey, the importance of the determined factors including the highest PL for commuter path choices was examined (first objective). In addition, the perceptual qualities of this research were measured as well (second objective).
The commuters as respondents to the second survey were followed along the pathways of each zone; after recording the traversed pathways, the survey questionnaires were submitted when they arrived at the metro stations on their evening walking trips. The reason for considering the evening walking trips of the commuters was that it was impossible to find the commuters of the selected workplaces in each zone during their morning walking trips, whereas they could be easily identified from the workplace gates in the evening. In the process of following commuters, anyone who stopped for a long time was not considered any further. Likewise, if any of the selected commuters did not arrive at the station, he/she was excluded from further consideration. This was because of the necessity of presence on the pathways and the fact that almost the same dedicated time was allowed in each zone to measure the perceived time for each of the traversed pathways.

A Morgan table was used to determine the number of respondents in the second survey.
This table is used when the total population size (that is, the number of commuters who walk in the CBD) cannot be determined (Krejcie and Morgan, 1970). In this way, 36 commuters in each zone and 324 commuters in all zones were selected as the respondents in the second survey. Questions included those that addressed the definition of PL and measurements of perceptual variables, including the level of PL and the degrees of comfort and pleasance along the pathways. Owing to having more variability in the data, which helps to achieve the significant final results (Kwon, 2007), a nine-point Likert scale was used to measure PL and other perceptual factors. Face validity, using expert opinions and the opinions of sample respondents, through a measurement of their inter-rater agreement, was used to validate the questions. Furthermore, test – retest reliability was used to examine the reliability of the questions used in the second survey questionnaire. The data were analyzed using SPSS version 16, and tests, comprising multiple regression, Pearson correlation, and t-test, were run (Paydar, 2013).

An observational analysis was used to examine the fourth objective. Before implementing the observational step, the components of PL – identified during the achievement of the third objective – were transformed to certain measurable physical factors along the pathways. During this observational survey, the PL components were measured along the traversed pathways of the commuters between metro stations and selected workplaces.

To implement these measurements, the traced pathways must be identified in each selected zone. In this study, the traversed commuter pathways were recorded on the map drawn by the researcher from their actual natural walking movement from their workplaces toward the metro stations during the implementation of the second survey (Paydar, 2013). This method is one of the most reliable for recording traversed pathways of pedestrians between two given locations (Golledge, 1995).

As part of the observational analysis, video clips were shot on all traversed commuter pathways, in a procedure similar to that used by Ewing and Handy (2009). Furthermore, a filming protocol was developed to ensure that our physical-factor raters were not biased in their reactions to street scenes by different filming techniques. The video clips were taken from the traversed pathways of the commuters identified within the second survey in each zone. These were done at the same time as implementation of the second survey, which was at 17:00. The physical factors were then counted by watching each of the video clips. The reliability of the measured physical factors from the video clips was achieved by using five individuals as coders and then measuring the degree of inter-rater reliability among them.

Results and Discussion

The importance of the highest PL among the other probable path choice criteria of commuters: The first objective

The quickest pathway, the most comfortable pathway, and the most pleasant pathway were found to be those making the highest contribution to path choice (Paydar, 2013; Group 1 in Table 1). The quickest pathway is the shortest in terms of time and distance (Seneviratne and Morrall, 1985). The highest PL meaning the stronger sense of direction toward the destination is counted as a moderately important factor in commuter path choice (Group 2 in Table 1). This factor is taken into account as a secondary criterion in commuter path choice. However, the quickest pathway and the most pleasant pathway as the most important path choice criteria are the assumed perceptual factors related to PL. Accordingly, the emphasis is on the importance of the second objective, in which the contribution of the highest PL to path choice influences the perceived time and level of pleasance.

Having found that the factors of quickest pathway, most comfortable pathway, and most pleasant pathway are the most important path choice criteria for commuters, this study shows that both of the scenarios defined in the introduction accurately reflect the situation in which alternative pathways of similar length can be selected from an origin to a given destination (Paydar, 2013).

This study’s identification of the shortest time and distance as the most important criterion in commuter path choice parallels the findings of several other studies on the criteria of pedestrian path choice (Seneviratne and Morrall, 1985; Golledge, 1995; Ovstedal and Ryeng, 2002; Kitazawa and Batty, 2004; Agrawal et al, 2008). Another important path choice criterion of commuters had to do with the most comfortable pathway. Sense of comfort affects the perceived quality of the walking environment as well as the pedestrian’s walking behavior (Ewing et al, 2006). Comfort is an important factor in the walking behavior of pedestrians, especially when walking...
for transport (Handy and Clifton, 2001; Alfonzo, 2005; Ewing and Handy, 2009). Isaacs (1998) has also argued about the importance of a sense of comfort for path preference of pedestrians in their daily transport. Therefore, having identified the most comfortable pathway as one of the most important path choice criteria of commuters is in accord with the results of the previous studies.

Ascertaining that a pleasant pathway is one of the most important path choice criteria supports the finding of Isaacs (1998), who found that pleasance is one of the essential esthetic affective responses that contributes to the path preference of pedestrians in their daily activities. Furthermore, the most pleasant pathway as a main esthetic component of path choice during walking was also found to be important during the commuters’ evening walking trips. Therefore, commuters select the pathways that provide them more esthetic experiences in their evening walking trips toward the metro stations. This can be attributed to the psychological concerns of commuters while they relieve themselves of their daily tasks. People are exhausted from working long hours, so they need to refresh themselves when returning home. Therefore, they need to have an esthetic experience, prompting them to choose their favorite walkway to reach the metro station.

A t-test was administered to examine the difference between males and females in terms of the importance of PL in path choice (Table 2). The P-value was 0.043, which is less than the threshold of 0.05, regarding the importance of PL in path choice based on gender. This shows that the strongest sense of direction toward the destination is significantly more important in the path choice of women as compared with that of men. Therefore, the following hypothesis is confirmed.

Hypothesis 1: The importance of the highest PL for path choice varies according to gender.

However, previous studies comparing males and females with regard to real-world spatial tasks have demonstrated that gender differences are minimal in cases where environments are familiar; the differences are much stronger in environments that are unfamiliar (Montello et al, 1999). That said, it has been shown that, on average, males perform better than females in way-finding tasks (Voyer, et al, 1995). According to Castelli et al (2008), performance of the male subjects was significantly better than that of females in all the tests designed to investigate spatial abilities. Likewise, according
to Silverman et al. (2000) and Lachini et al. (2009), males are significantly more accurate and faster at wayfinding in an already familiar environment. In addition, according to Cornell et al. (2008), females gave lower estimates of their sense of direction than males. Thus, it can be inferred that, because of the weakness of women’s way-finding abilities as compared with those of men, women rely more on having a stronger sense of direction in their path choice as compared with men. As a result, the strongest sense of direction or highest PL comes up more often as a more important path choice criterion for women compared with men.

Examine the indirect contribution of highest PL to path choice of the commuters: The second objective

A Pearson correlation was run among these variables in consideration of the correlations between PL and the perceptual factors consisting of the perceived time and the rate of pleasure along the pathways (Table 3). PL was found to have a significant correlation with perceived time and rate of pleasure along the pathways. The correlation coefficient between rate of the PL and the perceived time is −0.290. Furthermore, the correlation coefficient between the rate of PL and the rate of pleasure is 0.513. The correlation coefficient between the PL and the perceived time is negative. The more feeling of better directional pathway or stronger sense of direction toward the destination, the less walking time perceived by the commuters. Differently, the correlation coefficient between the PL and rate of pleasure is positive. The more feeling of better directional pathway or stronger sense of direction toward the destination, the more commuters have the pleasant walking trips. Therefore, it is concluded that the highest PL – in addition to its direct contribution to the path choice which was found in the first objective – contributes to the path choice of commuters in indirect ways.

<table>
<thead>
<tr>
<th></th>
<th>PL</th>
<th>Pleasure</th>
<th>Perceived time</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL Pearson Correlation</td>
<td>1</td>
<td>0.513”**</td>
<td>−0.290”**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>—</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>N</td>
<td>324</td>
<td>324</td>
<td>324</td>
</tr>
</tbody>
</table>

**Correlation is significant at 0.01 level (2-tailed).
And these indirect ways are via the significant negative correlations with the perceived time and significant positive correlations with the rate of pleasance along the traversed pathways of the CBD. On the basis of this, the following hypotheses are confirmed:

**Hypothesis 2:** Highest PL contributes to commuter path choice via the correlation with perceived time.

**Hypothesis 3:** Highest PL contributes to commuter path choice via the correlation with the rate of pleasance along the pathways.

The ‘storage size’ hypothesis provides a theoretical basis for the relationship between physical factors along the pathways and perceived time and distance. This hypothesis is based on the arguments of Milgram (1970), who suggests that when a set of surroundings contains too much information, size distortions occur in the human perceptions. Thus, pathways that contribute plenty of information generate a longer estimated time than the actual time and distance for commuters’ average walking trips. The empirical studies support this theory and show that several physical features along the pathways, such as the number of turns and intersections, contribute to the estimated time and distance (Sadalla and Staplin, 1980; Jansen-Osman and Berendt, 2002; Jansen-Osmann and Wiedenbauer, 2004; Yang et al, 2007). Higher PL or a stronger sense of direction along the pathways works against this overloading of information in the minds of commuters and consequently contributes to a lower perceived time. This means that the pathway that provides a strong sense of direction toward the destination, by having more directional cues such as a greater visibility of the destination, leads to an easier processing of time-related information. On the basis of the storage size hypothesis, a pathway that supports an easier processing of time-related information would generate shorter estimations of time and distance by commuters.

In this study, higher PL or a stronger sense of direction toward the destination contributes to a more pleasant pathway. A sense of pleasure is one of the essential esthetic affective responses for pedestrians’ walking preference in their daily movements, which in turn contributes to generating and intensifying their esthetic experiences (Isaacs, 1998). This study introduces the PL as a perceptual quality of the pathway which has the same effect on the commuters along the pathways of the CBD.

**The components of PL along the pathways: The third objective**

In the first survey using the qualitative approach, the respondents were asked to mention the factors that related to enhancing their sense of direction along their traversed pathways. Most of the responses were the names of buildings, which are located along the pathways in each zone. All of the selected buildings have a common characteristic in that they are particularly remarkable in the context of the surrounding buildings. These specific buildings are categorized into two major groups as follows (Paydar, 2013): the buildings determined by their specific appearance from their surroundings, and the buildings specified by their function (Table 4 and Figure 9). Indeed, the buildings of the first group are the landmarks that are specified by their appearance. This difference in the appearance of the buildings can also be categorized into two subgroups (Table 4 and Figure 9). The first subgroup includes the buildings in which the difference between their appearance and their surrounding is mostly due to their remarkable height relative to that of the surrounding buildings. The second subgroup consisted of those for which the difference between their appearance and the surrounding buildings is mostly due to their specific façade. Most of the buildings specified by their height (the first subgroup) also are belonged to the second subgroup, but not vice versa (Table 4). The number of the mentioned buildings and number of their total repetition related to each subgroup are shown in the Figure 9. The second group of the buildings includes those of which are specified by their function (Table 4 and Figure 9). Indeed, these buildings are certain restaurants. The main characteristic of these restaurants is that people sit and eat outside and in front of them.

Some of the responses within the first survey are the names of certain streets in the selected zones. It was found that all of the streets mentioned have a common characteristic in that all of them are the longest sections of the traversed way of the commuters (Figure 10). They are also the major streets of each zone. In addition to the names of the buildings, streets, several factors were mentioned as being related to the stronger sense of direction or higher PL (Figure 10). Indeed, there are direct relationships between these physical factors.
Table 4: Name of the buildings and their types in each zone mentioned by respondents regarding PL

<table>
<thead>
<tr>
<th>The zones of the study</th>
<th>No</th>
<th>The name of mentioned buildings in each zone</th>
<th>Number of repetition of each building in each zone</th>
<th>Buildings, specialized by their appearance</th>
<th>Buildings, specified by their functions (special restaurants)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Specified by their height</td>
<td>Specified by their façade</td>
</tr>
<tr>
<td>Bukit Bintang – Sumerset Seri Bukit Ceylon</td>
<td>1</td>
<td>Restoran The Green Man</td>
<td>1</td>
<td>—</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>KFC building</td>
<td>4</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Mcdonald building</td>
<td>1</td>
<td>—</td>
<td>✓</td>
</tr>
<tr>
<td>Padu – Pudu plaza</td>
<td>4</td>
<td>Restaurant</td>
<td>3</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>I.C. Electronics Sdn Bhd</td>
<td>2</td>
<td>—</td>
<td>✓</td>
</tr>
<tr>
<td>Titiwangsa – Am Assurance Building</td>
<td>6</td>
<td>Malaya Electronic Institute</td>
<td>2</td>
<td>—</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Fargoes Sdn Bhd</td>
<td>2</td>
<td>—</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Vistana Hotel Kuala Lumpur</td>
<td>4</td>
<td>✓</td>
<td>—</td>
</tr>
<tr>
<td>Masjid Jamik – Wisma Harwant</td>
<td>9</td>
<td>Restaurant</td>
<td>2</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Gedung Aneka Kandar</td>
<td>3</td>
<td>✓</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Coliseum Theater</td>
<td>1</td>
<td>—</td>
<td>✗</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>Masjid India</td>
<td>4</td>
<td>—</td>
<td>✓</td>
</tr>
<tr>
<td>Masjid Jamek – Hong Leong Bank Building</td>
<td>13</td>
<td>HSBC Bank Malaysia Berhard</td>
<td>3</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>RHP Bank Building</td>
<td>3</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>Central Market</td>
<td>2</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>Wisma Hamzah</td>
<td>1</td>
<td>✓</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>Bangkok Bank Berhad</td>
<td>5</td>
<td>✓</td>
<td>—</td>
</tr>
<tr>
<td>Station PWTC – Wisma Tan Chong</td>
<td>18</td>
<td>Condominium Bistari Lavendar</td>
<td>3</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>RentNow Serviced Apartments</td>
<td>4</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>Hotel Grand Central</td>
<td>1</td>
<td>✓</td>
<td>—</td>
</tr>
<tr>
<td>Masjid Jamik – Menara Olympia</td>
<td>21</td>
<td>McDonald Building</td>
<td>4</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>Bangunan Asia Insurance</td>
<td>2</td>
<td>✓</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>Muzium Telekom</td>
<td>3</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>ACCA Malaysia Sdn Bhd</td>
<td>3</td>
<td>✓</td>
<td>—</td>
</tr>
<tr>
<td>Bukit Bintang – ABOILLED/OR Center Grand Opening</td>
<td>25</td>
<td>Restaurant</td>
<td>3</td>
<td>—</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>7Eleven</td>
<td>4</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>27</td>
<td>KFC</td>
<td>3</td>
<td>—</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>Hong Leong Bank</td>
<td>1</td>
<td>✓</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>29</td>
<td>Hotel Putra</td>
<td>1</td>
<td>✓</td>
<td>—</td>
</tr>
<tr>
<td>Bukit Bintang – Menara Keck Seng</td>
<td>30</td>
<td>The Westin Hotel</td>
<td>1</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>JW Marriot Hotel</td>
<td>2</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>32</td>
<td>Pavilion</td>
<td>3</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Number of total mentioned buildings*: 24
Repetition of total mentioned buildings: 73

The buildings specialized by their function**
Number of these buildings: 3
Number of total repetition: 8

The buildings specialized by their appearance
Number of these buildings: 21
Number of total repetition: 65

The buildings specialized by their height
Number of these buildings: 12
Number of total repetition: 38

The buildings specialized by their specific façade
Number of these buildings: 17
Number of total repetition: 49

Figure 9: Number of the mentioned buildings and their repetition based on their types regarding higher PL.

Notes: * The buildings with at least two repetitions are counted at this diagram. ** All of the buildings specialized by their function are the restaurants with people who sit in front of them.
and the PL. On the basis of the number of repetitions of each factor, three groups were identified (Paydar, 2013) (Figure 10). Group 1 includes the factors with the high contribution to a stronger sense of direction or higher PL. The only factor of this group is: the presence of buildings specified by their appearance, whether height or façade. Group 2 includes the physical factors that show the medium contribution to higher PL. These factors are: (i) more ability to see the stations along the walkways, (ii) more directness of the pathways or less number of turns, (iii) existence of bazaar, and (iv) presence of the special restaurants (with people who sit and eat outside of them). And Group 3 includes the physical factors as least related ones to PL. These three groups and their including factors are shown in the Figure 10 as well.

The second question of this research is ‘What do commuters perceive as the components of highest PL along the pathways?’ The physical factors on the basis of their level of contribution are shown in Figure 10. Excluding the factors that show a low contributions to the higher PL of commuters (Group 3), the factors with the medium to high contribution are taken into account as the components of PL along the pathways of the CBD in Kuala Lumpur. These factors include those which belong to Groups 1 and 2 in Figure 10.

The building directs pedestrians to their destination while they are walking along the pathway (Allen, 1997; Lovelace et al, 1999). It becomes a landmark for commuters and newcomers within the urban context (Lovelace et al, 1999). However, it is mostly used in newcomer wayfinding, as compared with those with a high familiarity with the environment, such as commuters. Therefore, the results emphasize the supportive role these buildings play in commuter wayfinding, in addition to their role in newcomer wayfinding. Furthermore, previous studies did not mention the types of landmarks that contribute to a good directional pathway. In this study, height and façade were identified as the specifications of the buildings (landmarks) that contributed to a sense of direction and better directional quality. In addition, this study found that the locations of the landmarks, whether on choice points or not, are not related to commuters having a stronger sense of direction. A choice point, for example, a junction, is a location on the path that offers some alternative pathway that can be selected by the commuters. This result supports the results of Lovelace et al (1999), who found that the landmarks located at choice points are not related to better directional pathways for pedestrians who have a high familiarity with the context. Finally, regarding the first important component of PL – buildings (landmarks) specified by their height and façade – Allen (1997) found that mentioning landmarks increases as the end of the route is approached. In contrast to Allen, Lovelace et al (1999) found that the landmarks mentioned did not increase as the end of the route was approached. In this study, it was found that the number of landmarks increases by approaching the destination points but decreases in the last
part of the pathways, adjacent to the destination points. The end of the pathways is the area in which the stations are usually visible. Therefore, the decrease in the number of landmarks mentioned in the last part of the pathways is due to the visibility of the destination, which works as a directional cue and weakens the role of landmarks in enhancing the sense of direction toward the end of the pathway.

Other physical factors are those with a moderate contribution to commuters’ sense of direction. The visibility of the destination, or the ability to see the station, implies visual connectivity between different points along the pathway and the destination points (metro stations). This study’s identification of the visibility of destination and its relation to a stronger sense of direction parallels the results of Lovelace et al (1999), who stated that the visibility of the destination is the main directional cue along a pathway. Likewise, establishing that having fewer turns, or more direct pathways toward the destination, impacts one’s sense of direction is also in parallel with the results of Lovelace et al (1999), who found that pedestrians with environmental familiarity mostly mention the segments of the path with the longest length as their directional components. The longest lengths of the path imply those sections having the least number of turns. Furthermore, more directness in the pathways allows commuters to have more visual surveillance along the walkways and, consequently, more sense of direction. The impact of bazaar and restaurants with the aforementioned special characteristics, as factors which strengthen the sense of direction, are due to the cultural and social aspects of Malaysians. Most Malaysians prefer to eat their meals in the local restaurants that provide a seating area out front. In a traditional city, a bazaar was also a place for social, cultural and civic activities. In essence, the bazaar was the heart of the city and consisted of important and prestigious buildings (Pirnia, 2001). Therefore, the cultural and social aspects of bazaar contribute to their being directional cues for commuters.

### Measuring PL on the basis of its components along the pathways: The fourth objective

To answer this objective, the components of PL were first transformed to measurable physical factors along the pathways. The first important component – the presence of buildings specified by their height and façade – was divided into two subgroups. The first group is the number of specific, visible buildings clarified by their appearance, whether height or façade. The second group includes the number of visible, special buildings identified only by their height. This categorization is made to find the role of buildings’ height in providing a stronger sense of direction for commuters. To measure the ability to see the stations, the nearest location of the path from which the station is visible, was marked on the map. The percentage of the distance from this location to the station, in relation to the whole length of the path determines the rate of visibility of the station along each of the traversed pathways. The factor of more directness of the pathways or fewer number of turns was divided by the total number of turns, and the number of right angle only turns along the traversed pathways. A bazaar exists only in two selected zones of the study. This is also true for the presence of restaurants with an outdoor eating area. This kind of restaurant also exists in three selected zones of study. As these two factors cannot be generalized and transformed to measurable factors among all the selected zones, they were excluded from further consideration in the fourth objective. The degree of inter-rater reliability (ICC) and the use of Cronbach’s α to describe the physical factors counted from the video clips are shown in Table 5. For each of the factors, there was almost perfect agreement (ICCs > 0.8) among the team members.

To find the correlations between the rates of PL components and the rate of PL (independent variables), multiple regressions were run. Table 6 shows the regression equation. According to Table 6, one factor shows a significant correlation with the perceived legibility: the number of buildings, specified by their height and façade.

### Table 5: Inter-rater reliability for estimates of physical factors

<table>
<thead>
<tr>
<th>Variable</th>
<th>ICC</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of people who walk (move) along the same side</td>
<td>0.993</td>
<td>0.999</td>
</tr>
<tr>
<td>Number of people who stop along the same side</td>
<td>0.985</td>
<td>0.997</td>
</tr>
<tr>
<td>Number of visible specific buildings clarified by their appearance</td>
<td>0.979</td>
<td>0.996</td>
</tr>
<tr>
<td>Number of visible special buildings, clarified by only their height</td>
<td>0.931</td>
<td>0.985</td>
</tr>
</tbody>
</table>
To have a more accurate equation from the regression, the independent variables which show the non-significant correlation with perceived legibility were deleted and we ran the regression analysis with only the independent variables that showed a significant correlation with the perceived legibility. This regression equation is shown in Table 7. According to Table 7, the regression equation is as follows:

\[
PL = 0.678 \times (\text{number of buildings specified by their height and facade}) + 24.158
\]

The regression equation shows that the rate of PL along the pathways of the CBD can be strongly predicted by the number of buildings that are specified by their height and façade. The coefficient of 0.678 for this factor shows that it can strongly predict the rate of PL along the traversed commuter pathways.

The importance of both height and façade for the specification of the buildings that contribute to higher PL was discovered in the process of examining the third objective. In response to the fourth objective, it was found that the number of buildings, specified by only their height did not show a significant correlation with the rate of PL along the pathways. This finding emphasized that the buildings contributed to commuters’ sense of direction with their height and façade rather than by relying on any specific architectural appearance.

This shows that PL can be measured based on its components, which were found in the process of investigating the third objective.

### An additional analysis

An additional analysis was also run. The number of buildings specified by their height and façade is a main indicator of PL in this study. Within these additional analyses, the correlation between this physical factor and other perceptual factors, including perceived time and sense of pleasance, were also examined. It was found that the number of buildings or landmarks specified by their height and façade showed a significant negative correlation with the perceived time and a significant positive correlation with the sense of pleasance along the walkways.

The number of buildings specified by their height and façade is also a main indicator of commuters’ sense of direction. Therefore, the function of this physical factor, in relation to perceived time, should be similar to the function of the sense of direction regarding perceived time. Therefore, a stronger sense of direction and an increased number of the buildings specified by their height and façade, by simplifying and quickening the process of retrieving time-related information along the pathway in the mind of commuters, contributed to a lower perceived time.

---

**Table 6: Multiple Regression equation analysis among PL and rates of its components along the pathways**

<table>
<thead>
<tr>
<th></th>
<th>Unstandardized coefficients</th>
<th>Standardized coefficients</th>
<th>t</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>β</td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>23.213</td>
<td>2.284</td>
<td>—</td>
<td>10.165</td>
</tr>
<tr>
<td>Number of right angle turns</td>
<td>0.106</td>
<td>0.059</td>
<td>0.132</td>
<td>1.784</td>
</tr>
<tr>
<td>Number of turns</td>
<td>−0.087</td>
<td>0.073</td>
<td>−0.090</td>
<td>−1.191</td>
</tr>
<tr>
<td>Number of specific buildings with their height and façade</td>
<td>0.686</td>
<td>0.033</td>
<td>0.791</td>
<td>21.005</td>
</tr>
<tr>
<td>Number of specific buildings with their height</td>
<td>−137</td>
<td>0.054</td>
<td>−0.14</td>
<td>1.651</td>
</tr>
<tr>
<td>Visibility of stations</td>
<td>−0.010</td>
<td>0.038</td>
<td>−0.010</td>
<td>−0.268</td>
</tr>
</tbody>
</table>

Dependent Variable: PL

**Table 7: Multiple Regression equation analysis after eliminating the insignificant factors among the PL and rates of its components along the pathways**

<table>
<thead>
<tr>
<th></th>
<th>Unstandardized coefficients</th>
<th>Standardized coefficients</th>
<th>t</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>β</td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>24.158</td>
<td>1.622</td>
<td>—</td>
<td>14.891</td>
</tr>
<tr>
<td>Number of buildings specified by their appearance</td>
<td>0.678</td>
<td>0.030</td>
<td>0.782</td>
<td>22.478</td>
</tr>
</tbody>
</table>

Dependent Variable: PL
Furthermore, this study’s finding that the buildings, as landmarks, contribute to a pathway’s esthetic attributes and a sense of pleasance, parallels those of Isaacs (2000), who found that the presence of landmarks, as visual focal points and orientation aids, is one of the components that contributes to intensifying the esthetic experience along the pathways.

Conclusions

This study was conceived based on the key question of what path choice criteria, other than shorter time and distance, commuters use in situations where they can choose between alternative pathways that are of similar length between stations and their workplaces. Two scenarios were discussed, one of which raised the importance of perceived time and distance as opposed to shorter time and distance as a criterion of commuter path choice. PL was the main perceptual factor in this research, and this study identified PL as one of the alternative path choice criteria of commuters as opposed to the least perceived time.

Having found that the quickest pathway, most comfortable pathway, and most pleasant pathway are the most important path choice criteria for commuters, shows that both the scenarios described in the introduction are encountered in situations where some alternative pathways with almost the same length can be selected from an origin to a given destination. Regarding sense of comfort, it could be assumed that physical barriers, and especially the number of pedestrians along the walkway are main indicators of a sense of comfort such that commuters would likely avoid much interaction with other pedestrians. This is owing to the fact that they walk along the walkways during peak hours. However, the components of sense of comfort along the pathways of the commuters in CBD should be investigated further in future studies.

The first question of this research was whether the highest PL is taken into account as the most important path choice criteria of commuters in case of the availability of alternative pathways with almost the same length. The highest PL, or the strongest sense of direction toward the destination, showed moderate importance in commuter path choice (Figure 11). Furthermore, a stronger sense of direction contributed to lower perceived time and more pleasant walking trips for commuters. Lower perceived time and a more pleasant experience are two of the most important criteria in commuter path choice (Figure 11). Therefore, it was found that strongest sense of direction, via the correlation with perceived time and sense of pleasance, contributed to commuter path choice as well. These relationships showed that the strongest sense of direction toward the destination (highest PL) is one of the key factors affecting commuter path choice in the CBD, and it should be involved in studies on pedestrian behavior and path choice on a micro scale, such as the shortest pathways in the CBD.

The importance of the highest PL in commuter path choice highlights the necessity of considering

Figure 11: The overview of the findings.
Note: * Having found the quickest pathway as the most important criteria in commuter path choice implies the least perceived time on the basis of the design of this research.

Components of PL:
1. Most presence of the buildings specialized by their height and façade
2. Most visibility of destinations
3. Most directness of the pathways
4. Most presence of bazaar
5. Most presence of the restaurants in which people sit and eat outside of them

Path choice of commuters in CBD
(In the situation that some pathways with almost the same length are presented to the commuters)

The quickest pathway (Least perceived time in this research*)

Highest contribution

Significant negative correlation

The most pleasant pathway

Significant positive correlation

Gender difference was found

Most Pleasant pathway

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its components along the pathways. In this regard, it was demonstrated that five factors as components of PL or sense of direction, showed moderate to high importance in relation to commuter PL (Figure 11): the presence and quantity of the buildings specified by their height and façade, an increased ability to see the station while walking, greater directness of the pathway, the existence of a bazaar, and the presence of restaurants that had people sitting and eating in front and outside of them. Therefore, the pathways that show higher rates of these physical factors are more used by commuters for walking between the stations and adjacent workplaces in the CBD. This is due to the role these factors play in generating a stronger commuter sense of direction, or a stronger PL. Increasing the number of buildings (landmarks) specified by their height and façade not only helps the newcomer to find their way toward their destinations, but also has a remarkable effect on the commuters’ sense of direction toward the station, which leads to an increase in the number of commuters walking along the pathways of the CBD. This suggests that strengthening the policy of locating the major landmarks in city centers and CBDs would contribute to encouraging different groups of pedestrians to walk in these areas. For improving the visibility of destinations one can focus on increasing the height of the buildings located around the metro stations in city centers so that they can be visible along the pathways that reach them. Therefore, locating such high-rise buildings and considering their visibility from different major pathways around the station could be a useful policy in designing city centers so as to encourage people to walk. More direct pathways also improve the path choice and walking behavior of commuters in the CBD. This shows that city centers with a grid pattern and small blocks discourage walking among commuters. Moreover, the street patterns as well as the pathways in city centers should be designed in a way that increases the number of long straight sections toward the metro stations.

Two of the components of a sense of direction found in this research, included the local bazaar and the number of restaurants in which people sit and eat outside; these are new factors in regards to wayfinding and pedestrians’ sense of direction in the city center. The cultural and social aspects of the people in Malaysia explains the importance of these two factors regarding their sense of direction. Many local people in Malaysian cities would like to eat their meal in the spaces outside of the restaurants. Being interested in the presence of such an activity contributes to highlighting the restaurants with regard to pedestrians’ sense of direction along the pathways. The presence of the local bazaar as a place of social activities may also be of visual interest for people in Kuala Lumpur and one which contributes to their sense of direction. These cultural and social concerns of the Malaysians can be investigated in future studies. The presence of these types of the restaurants as well as the local bazaar should be considered in designing city centers, especially in East Asian cities in order to improve the path choice and walking behavior of the people in these areas. The former factors also show that it is important to investigate how the design of buildings and urban spaces functions in their context regarding the social and cultural concerns of frequent users.

This study introduces two new factors in relation to pedestrians’ perceptions of time: sense of direction, or perceived legibility, and the number of landmarks specified by height and façade. Both of these factors showed significant negative correlations with how commuters perceived time. The relationship between these two factors and the commuters’ perception of time in walking should be studied more deeply in the future research.

In this study, a higher PL and the number of buildings specified by their height and façade contributed to more pleasant pathways and the esthetic experience of the commuters. The role of landmarks in generating the esthetic experience of pedestrians has been mentioned by others. However, this research identifies the role played by sense of direction in generating and intensifying the esthetic experiences of pedestrians.

More research should focus on the micro scale path choice criteria of commuters in the CBD to obtain a more generalizable understanding of commuters’ path choice criteria between metro stations and workplaces. This study focused on commuters’ evening walking trips because of limitations in collecting data on morning walking trips; however, future research may include morning commutes for a fuller picture. Furthermore, this research focused on commuters and their walking trips between metro stations and their workplaces in Kuala Lumpur’s CBD. This focus was chosen because commuters are the major group of pedestrians who walk between metro stations and workplaces along the pathways of the CBD. The path choice criteria of other pedestrians who want to reach other destinations could also be examined in future research. Moreover, this
research examined the correlations between perceptual qualities consisting of PL, perceived time and the level of pleasure along the pathways. However, the cause and effects between these perceptual factors could be further examined by EMOS and other related software in future research. Finally, the landmarks in this study were specified by their appearance, including height and/or façade. As such, other types of landmarks and their relation to a sense of direction and pedestrians perceptions of time could also be stressed further in future studies.

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