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Familiarity Factors of Street Features in Pedestrian Wayfindings

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ABSTRACT

From an origin point to a destination point, good wayfinding process requires familiar recognition on the street environment. However, the unclear reasons of identifying street features to determine a route to the destination influences a pedestrian to select the wrong turn, walk in longer distance, and lost his direction. This paper aims to identify the factors that influence pedestrian familiarity, familiar or unfamiliar, in people wayfinding. Two hundred questionnaires were collected in Teluk Intan, Perak, Malaysia. Quotations from 30 interviews were used to triangulate the findings. Factor analysis available in IBM SPSS version 21 was used in exploring the familiarity factors for wayfinding. The finding suggests three factors influenced pedestrian to familiar with the street environment, which the factors are characteristic, attraction, and interest of street features. While, the duplication design of street features, error in defining the position of street features and form similarity of street features influence pedestrian to become unfamiliar with the street environment. This paper implies that the physical form of street features gives impact to pedestrian familiarity. Consideration of the three factors that influence pedestrian to familiar with the environment can improve how pedestrian experience in street network especially wayfinding.

1. Introduction

In a street network of a town, pedestrians start scanning the environment, organize their position, locating the destinations, recognize the street features, and refine the route to the destination. Indirectly, they have involved with wayfinding. Wayfinding involved with the ability and process of locating the destination by using route. It is the psychological process of pedestrian in referring, recognizing, judging, defining, and deciding the environment to find the route (Anwar and Amalia, 2017; Carlesimo et al., 2015; Gimbel, Brewer, and Maril, 2017; Lingwood et al., 2018; Moskat et al., 2018; Wan Mohamad and Said, 2017; Wang and Cheng, 2018; Zijlstra et al., 2016). At the same time, it requires ability to identify, plan, move, and reach the destinations (Gimbel, Brewer, and Maril, 2017; Lingwood et al., 2018; Zijlstra et al., 2016). Therefore, wayfinding is defined as the behavior and cognitive process of finding route to the destination in the street environment. However, the reviews is still lack on the connecting cognitive process to behavioral process.

The efficiency in wayfinding depends on the pedestrian's familiarity with the street environment, either familiar or unfamiliar. Familiar is the intuition from pedestrian's knowledge to recognize the street environment while unfamiliar is on the contrary (Wang et al., 2018). Familiar of pedestrians with the environment influences them to define a better route to the destination. Familiarity is related with the information gain by pedestrian. Familiar pedestrians depend on their internal sources, which are the information on street features that they remember (Hami and Tarashkar, 2018). Hence, they move in the familiar environment according to their hypotheses about the route, deduct the route that they not prefer, and follow their instinct (Wang et al., 2018). Therefore, the street features such as landmark function as reference for them which contribute to their spatial information, thus directional information such as signage are not useful (Suzer, Olgunturk, and Guvenc, 2018; Wang et al., 2018). Meanwhile, fail to recognize the street environment exposes pedestrian to become unfamiliar. Due to the new development or new experience to the environment, the information of street features gained make them confuses to decide which turn to select or route to use in reaching the destination (Suzer, Olgunturk, and Guvenc, 2018). Hence, unfamiliar pedestrian depends on external sources such as signage or asking others to gain information in deciding the direction (Hami and Tarashkar, 2018; Wang et al., 2018). Therefore, unfamiliar pedestrians can misinterpret with the information gain from others, accordingly expose them to make mistake or lost direction. The reviews presents the limitation in defining why pedestrian experience unfamiliarity.

However, street network of a town often exposes wayfinder to become unfamiliar with the environment. Accordingly, Mandel and LeMeur (2018) presents four difficult situations in wayfinding. Firstly, lack of spatial information presented by about positions, locations, and directions. Secondly, the information gained in the street does not match with their memory on the place. Next, difficulty in asking other pedestrians limits the information gathered. Lastly, there is no external source such as maps or mobile navigation systems available during

travel. Therefore, this paper aims to identify the factors that influence pedestrian familiarity, familiar or unfamiliar, in their wayfinding. By identifying the factors of familiarity, the better design consideration of street features for pedestrians to experience better wayfinding as a guide to architects, landscape architects, and urban planner. This paper hypothesizes that street features in small town are multi-dimensional in familiar and unfamiliar environments. Hence, the null hypothesis is street features in small town are uni-dimensional in familiar and unfamiliar environments. Pedestrians' familiarity, familiar and unfamiliar, is measured in exploring their perception on the street features during searching for information to define the route to the destination.

2. Methodology

2.1 Survey Questionnaire

This paper employed survey questionnaire as the main instrument to collect statistic information on perception of pedestrian wayfinding (Cohen, Manion, and Morrison, 2007). Survey questionnaire was used to measure two parameters, namely, (a) diversity of street features, and (b) familiarity in wayfinding. Diversity of street features consists of collecting points, landscape elements, buildings, and streets elements. The street features (n=10) are landmark, square, jetty, walkways, stalls, park, special buildings, trees, shrubs, and grassed area. The street features are commonly identified in Malaysian small town as suggested by Wan Mohamad and Said (2016). Meanwhile, familiarity in wayfinding refers to pedestrians' perception on how the street features make them familiar or unfamiliar with the street environment. Hence, each street feature was assessed on how it can assist or confuse the pedestrian in their wayfinding process.

Based on Dual Process Theory by Evans and Stanovich (2013), the street features are judged by pedestrian according to intuitive and reflective process which are developed from human cognition. Intuitive means pedestrian feels unfamiliar with the street features that reflect to the recollection of the information to find the right route. While, reflective process means pedestrian feels familiar with the street features that reflect pedestrian to select the right route spontaneously. Therefore, the questionnaire consists of two questions: (a) which level do street features help you to recognize the way to the destination? and (b) which level do street features make you confused and lost in the way to the destination? The answer was in Likert scale. The scale used to assess the level of street features in influence pedestrian to familiar were (1) highly not assist, (2) not assist, (3) assist, and (4) highly assist. While, the scale for pedestrian to assess the street features that may confuse them in wayfinding were (1) highly not confuse, (2) not confuse, (3) confuse, and (4) highly confuse.

Based on Fowler's sampling error formula (Creswell, 2012), percentage of sampling error for 100, 200 and 300 are 10%, 7% and 6%, respectively. By comparing percentage of sampling error for 100, 200 and 300, there was a difference by 3% between sampling size 100 and 200 while 1% for sampling size 200 and 300. Considering the worthwhile to collect the sample according to the percentage of sampling error, this study used 200 as sample size for survey questionnaire with 7% of sampling error and 93% of confident interval.

On February, 2014, the survey was conducted on 200 pedestrians who travel in Teluk Intan, Perak, Malaysia which was decided according to Fowler's sampling error formula 1988 (Creswell, 2012). Located in northern region of Malaysia peninsular and southern of Perak, Teluk Intan is a small town with population of 41,701. The town was founded by Sir Archibald Edward Harbord Anson during colonial era 1882. After Malaysian independence 1957 until present, the town is authorized by Malaysian Government with total area of 72 hectares which consists of old and new zones where old zone area listed as historical town conserved by Federal Department of Town and Country Planning Peninsular Malaysia (2006).The survey was conducted at 20 collecting points of the most visited points identified by Wan Mohamad and Said (2016) which are two shopping malls, a landmark, a square, a jetty, two taxi stations, two bus stops, two playgrounds, two parks, three banks, and four stalls. The survey was conducted with help of two trained assistants which were the former students of Landscape Architecture program, Universiti Teknologi Malaysia who graduated in 2011. Permission letter provided by Faculty of Built Environment, Universiti Teknologi Malaysia was used to gain the cooperation from respondents and to declare that the information obtained are officially confidential and only used for this research (Creswell, 2012). This study used Cronbach alpha to measure reliability according to the internal consistency of the data collected (Cresswell, 2014). Accordingly, the values of Cronbach alpha for familiar and unfamiliar were 0.853 and 0.833 respectively. This means the questionnaire used in collecting the data for measuring perception of pedestrian familiarity was reliable because the values of Cronbach alpha in within 0.7 to 0.9 (Tavakol and Dennick, 2011).

The data of survey questionnaire were analyzed using exploratory factor analysis to define the factors that influence pedestrian to be familiar or unfamiliar with the street features (Costello and Osborne, 2005; Froman, 2001; Matsunaga, 2010). This study exploring the factors that affect pedestrian familiarity after perceiving street features in the town environment. Hence, exploratory factor analysis is an appropriate analysis tool to evaluate pedestrian perception in exploring the factors. The analysis involved with two tests: (a) Kaiser-Meyer-Olkin (KMO), and (b) Bartlett's test. Hence, this analysis was used to test the hypothesis of this study, which is street features in small town are multi-dimensional in familiar and unfamiliar environments. The hypothesis was accepted when p-value less than 0.05 ($p<0.05$) and indicates that results are significant. In extraction and rotation, the number of factors that influences pedestrian perception on street features was defined according to Kaiser Criterion suggested by Costello and Osborne (2005) with eigen values greater than 1.0. Accordingly, the results of factors were interpreted based on the items factors collected.

2.2 Interview

This paper employed interview method to obtain specific knowledge of pedestrian experience wayfinding in street network of small town (Cohen, Manion, and Morrison, 2007). Face-to-face interview session was conducted on 30 pedestrians who travel to two points, wet market and bus stop in Teluk Intan, Perak, Malaysia. As discussed by Gillham (2005), 30 is the sufficient sample size for the interview. The information used to support or explain the findings interpreted form the analyses. They were asked with the semi-structured questions which developed from the results of statistical analysis (Kumar, 2014). The interview sessions were conducted in Malay and lasted between 10 to 15 minutes. The interactions between researchers with the participants were recorded by using MP3 Digital Recorder. The data from interview was analyze using content analysis to examine and verify of the content gathered from pedestrians' responds in experiencing wayfinding in Teluk Intan, Perak (Matthews and Ross, 2010). The data were transcribed verbatim in Malay and translated into English. Then,

the transcripts were categorized according to the parameters measured to explain the obtained results from factor analysis. Accordingly, the quotations from this content analysis were summarized to support the findings.

3. Results and Discussion

Data from survey questionnaire were analyzed using factor analysis to identify the factors of street features that influence pedestrian wayfinding. The analysis is used to determine the street features belong to the sets of factor. Hence, the set of street features explain the reasons of pedestrian recognize the route or confuse with the direction to the destination.

Table 1 presents that the values of KMO measurement for familiar and unfamiliar environment is 0.858 and 0.829, respectively, within range 0.6 to 1. Therefore, the result suggests that the analysis possesses the strong interrelationship to identify the factors for familiar and unfamiliar environments (Tabachnick and Fidell, 2014). Accordingly, the data from 200 pedestrians are sufficient to determine the factors.

Table 1 *KMO and Bartlett's test for familiar and unfamiliar environment*

Description		Familiar	Unfamiliar
Kaiser-Meyer-Olkin Measure		0.858	0.829
Bartlett's Test of Sphericity	chi-square	1200.603	1127.509
	df	105	105
	p-value	0.000	0.000

For Bartlett's test, Table 1 shows that both p-value for familiar and unfamiliar environments achieve the significant level where p-value less than 0.05 which is 0 (Chua, 2008). Hence, the null hypothesis is rejected. This suggests that street features in small town are multi-dimensional for familiar and unfamiliar environments. These means the set of street features possess factors in influencing pedestrians to familiar or unfamiliar with the street environment. Loading from pattern matrix of principle component analysis is assessed to define and interpret the factors that influence wayfinding process. Therefore, the discussion on factors is divided into two: (a) familiar, and (b) unfamiliar.

3.1 Factors for Familiar

Table 2 presents three factors that influence pedestrians to familiar with the street environment, namely, Factor 1, Factor 2, and Factor 3.

Table 2 indicates that Factor 1 consists of four street features which are

Table 2 *Loadings of street features for familiar environment*

Street Features	*Factor 1*	*Factor 2*	*Factor 3*
Shrubs	0.828		
Grassed Area	0.823		
Trees	0.809		
Walkways	0.419		
Square		0.711	
Landmark		0.672	
Stall		0.616	
Park			0.767
Special Building			0.615
Jetty			0.402

shrubs (0.828), grassed area (0.823), trees (0.809) and walkways (0.419). According to the street features, shrubs, trees, and grassed area possess prominent characteristic (Figure 1). For instance, the red color of the flowers emphasizes the prominent characteristics of Bougainvillea spp. (Bougainvillea) at Sekolah Street. The green-yellow color of Ficus benjamina (Weeping Fig) leaves attracts pedestrians' attention to recognize Ah Cheong Street. The green character of grass, Axonopus compressus (Cow Grass) is planted in a huge space attract pedestrian to remember. The brightness color of leaves develops pedestrians' attentions to the shrubs, trees, and grassed area to record the spatial orientation. As a result, they tend to refer to the area when experience the environment again. This suggests that the prominent characteristic of the street features influences pedestrian to recognize route. Some pedestrians commented that:

"This flower (Bougainvillea) easy remained me with this street (Sekolah Street)."

"You can easily see this trees (Weeping Fig) when walking along this street (Ah Cheong Street)."

"There always held the events at this place (playfield)."

The children feel familiar to the environment when encounter the features with characteristics that appear according to bright color (Helvacıoğlu and Olguntürk, 2014). However, the finding identifies a difference that color can accentuate the characteristics of street features as the factor in influencing pedestrian to familiar with the environment, which not only for children.

The characteristic of walkways is stimulated by the facades of old and new buildings where pedestrians influence to remember the route to the destination (Figure 1). As commented by a pedestrian;

"This town (Teluk Intan) becomes special because it has these buildings (by showing the facades of old zone)."

The facades of historic buildings give meaning to the locals (Carmona, 2014). However, the finding modifies that the characteristics of walkways and facades of buildings associate with pedestrian recognition to recognize the route to the destinations. Accordingly, Factor 1 is defined and interpreted as prominent characteristic of street features as a factor for pedestrian to familiar with the street environments.

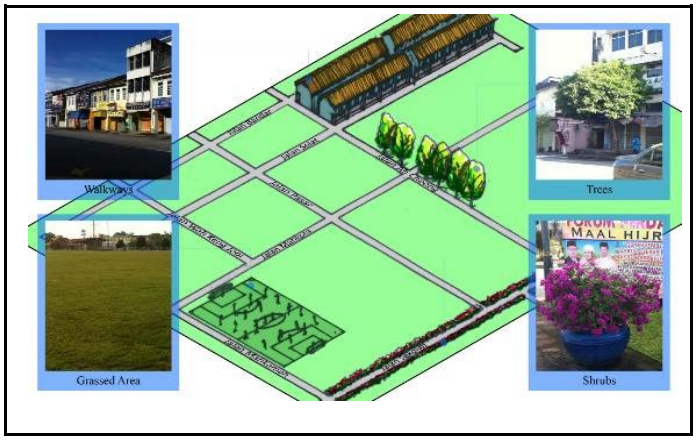


Figure 1 *The prominent characteristic of street features influences pedestrian to familiar with the streets*

In Table 2, three street features generate in Factor 2, namely, square (0.711), landmark (0.672), and stalls (0.616). Square is a tourism spot in Teluk Intan. The place is used by the locals or tourists as a gathering point. Attached with Menara Condong which is the landmark of Teluk Intan makes square as a significant gathering (Figure 2). Built by British in colonization era which was a water tank for the town, Menara Condong is now a clock tower and recognized as a historical building in Malaysia. While, stalls become popular among the locals because it sells local dishes as Mee Rojak and Mee Kicap. The recognition of the locals on the street features makes the places as an attraction and well known. As stated by a pedestrian;

"This is the gathering point for tourists (pointing at square and Menara Condong (landmark)."

"The best Mee Kicap Stall is at food court near Pasar Street."

As a result, square, landmark and stalls assist in pedestrians to recognize street environment and route to the destinations. Landmark represents as attraction for navigation (Ferretti et al., 2013). But, the finding indicates that square and stalls are also included as the street features evoked pedestrian attraction to the environment. Therefore, Factor 2 is defined and interpreted as place of attraction influence pedestrian to familiar with the street environment.

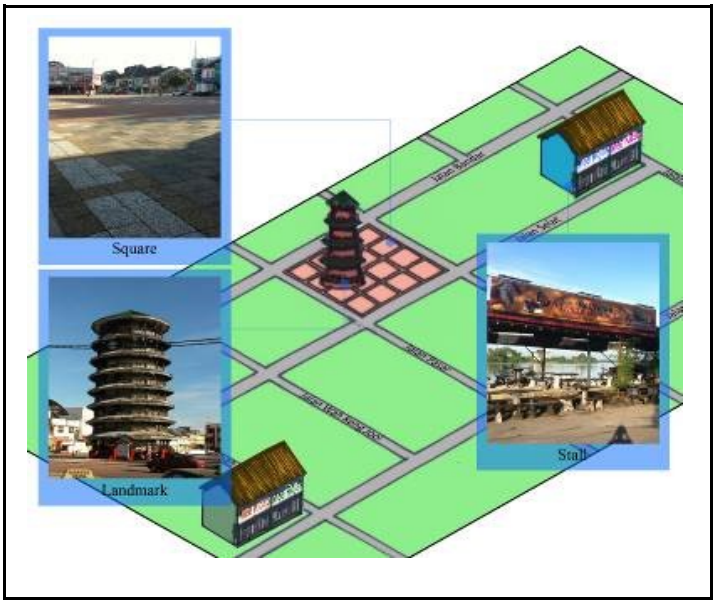


Figure 2 *The attractiveness of street features influences pedestrian to familiar with the street environment*

Table 2 presents three street features identified in Factor 3 which are park (0.767), special buildings (0.615), and jetty (0.402). According to Figure 3, the street features associated to create interesting feeling for pedestrian which stimulated by the design and function. Park is the highest loading in influencing pedestrian to familiar with the street environment. Landscape architect designed park to offer space for recreation in group. Thus, park becomes useful places for the locals to interest activities such as jogging, aerobic exercise, and family gathering. While, special building such as hospital, police station, or shopping mall provides services and necessities for health, security, foods, and daily needs. The necessities provided by shopping mall fits with local needs. This makes shopping mall as an interesting place by the locals. Similarly, Teluk Intan jetty connects the locals with other places such as Sembilan Island through Perak River interest the locals with the feature. Hence, the jetty is a significant street feature to recognize in Teluk Intan. For instance, some pedestrians said that;

"My family and I always visit the park during weekend for recreation."

"After The Store, there is a junction. We take right to Sekolah Street."

"After Teluk Intan Jetty, there a junction with traffic light, take right."

Park, special buildings, and jetty, the only feature in the town, hence, encourages pedestrians to recognize the direction to the features. For example, pedestrians are guided to recognize the route when perceived the jetty at Mahkamah Street (Figure 3). Pedestrian gain knowledge on jetty though their experience on using it. The recognition of park, special buildings, or jetty consequently oriented pedestrian to define direction to the destination when perceived the features.

Figure 3 *The interesting street features in influencing pedestrian to familiar with the street environment*

Routes were selected according to features that always used by pedestrian such as well-known streets (Holscher, Tenbrink, and Wiener, 2011). However, the finding identifies that well known streets occur when pedestrian experience the streets by using special buildings or jetty.

Park, special buildings, and jetty contribute pedestrian recognition as interesting elements in small town. Therefore, Factor 3 is defined and interpreted as the interesting elements in influencing pedestrian to familiar with the street environment.

3.2 Factors for Unfamiliar

Table 3 presents three factors that influence pedestrians to unfamiliar with the street environment which are Factor A, Factor B, and Factor C.

Three street features are accumulated on Factor A, namely, walkways (0.714), stall (0.542), and park (0.534). In Teluk Intan, the street

features are built by local authorities at various locations. Teluk Intan possesses with 117 walkways consisted of five-foot walkways at old and new buildings. The walkways are built in front of the old and new buildings' façades to provide walking space for pedestrians when travel in the town. This means the walkways depend on the buildings. The numbers of

Table 3 *Loadings of street features for unfamiliar environment*

Street Features	*Factor A*	*Factor B*	*Factor C*
Walkways	0.714		
Stall	0.542		
Park	0.534		
Landmark		0.741	
Square		0.728	
Jetty		0.565	
Special Building		0.527	
Shrubs			0.855
Trees			0.809
Grassed Area			0.748

walkways in old and new buildings make the environment look similar (Figure 4a). For instance, the similar environment of walkway in Intan 5 Street with walkway at Intan 6 Street confuses pedestrians. Similarly, the town possesses fourteen stalls which provided at Bandar Street, Syed Abu Bakar Street, Pasar Street, and Sekolah Street (Figure 4b). Therefore, their process to define route to the destination is interrupted when encounter walkways and stalls. Some pedestrians commented that;

"Both buildings in this area look similar to me. So, no differences if I walking here (walkway) or there (walkway of another building)."

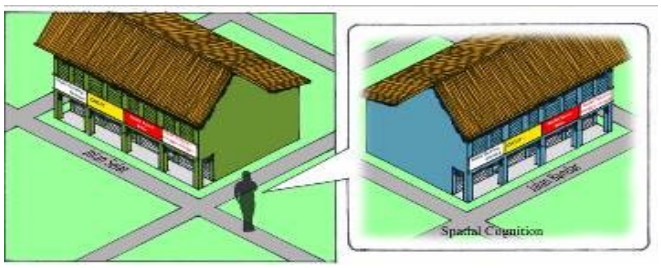
"I thought this is the right way, this stall looks similar with another stall which selling the similar dishes."

Hence, the similarity in physical appearance of the street features generates pedestrians' memory to misjudge the information. Similar design in two different areas brings difficulty to pedestrian in recognizing the identity of the streets (Suzer, Olgunturk, and Guvenc, 2018). However, the finding explores further that the similarity in design of street features brings the similar effect for pedestrians to recognize the street environment, which influence them to feel unfamiliar with the streets.

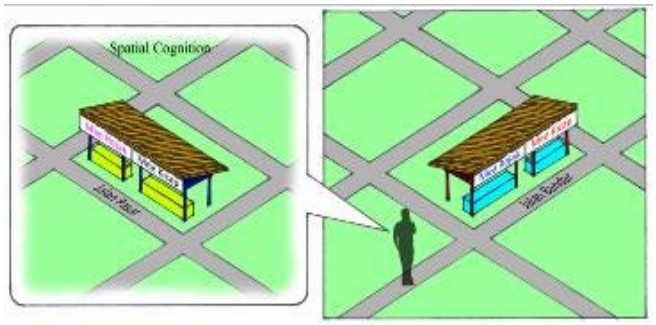
Meanwhile, the impact of park is different. Pedestrian confuses with the street environment after perceiving the duplication of softscape and hardscape in park such as shelters, pavements, and benches. The landscape elements are provided by local authority with a similar design. For instance, benches in the park at Teluk Intan-Bidor Street are similar with the benches in another pocket park at Speedy Street. The similarity is according to material and color used such as pebble-washed finish and yellow (Figure 4c). Hence, pedestrian could presume the park at Teluk Intan-Bidor Street is the pocket park at Speedy Street when perceived the landscape elements in the park. As a result, the similarity associates to the error route selection in the wayfinding process. A pedestrian described about park;

"In this park, we can find benches and trees which look similar with other park at Speedy Street."

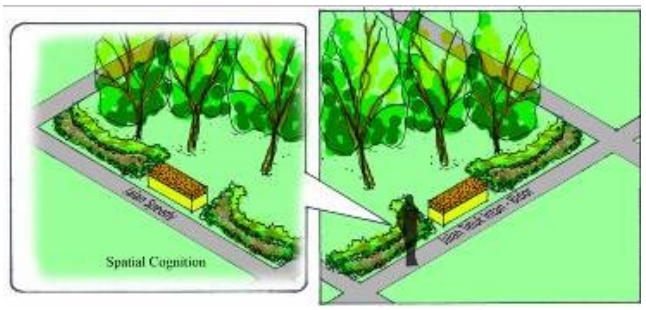
The idea of 'cloned' streets decreases pedestrian's recognition on the streets (Carmona, 2014). But, the finding describes further that the similarity in design of street features in street environment induces



a) Similar design of walkways



b) Similar design of stalls



c) Similar design of benches in parks

Figure 4 *Design duplication of walkways, stalls, and park confuses pedestrian to define route*

pedestrian to unfamiliar with the streets. Therefore, walkways, stalls, and parks define and interpret Factor A as design duplication of street features associates to interrupt pedestrian wayfinding process.

On the other hand, Table 3 presents four street features accumulated on Factor B which landmark (0.741), square (0.728), jetty (0.565), and special buildings (0.527). Landmark, square, jetty, and special buildings are the recognized features by the locals, but not excluded to interrupt pedestrian during travel. The confusion occurs due to the positions of the street features with pedestrian. Positions of pedestrian are various. For instance, pedestrians who recognize the landmark from Position A which commonly travel with regular route (blue route) could confuse with to decide another route from Position B (Figure 5). They could misjudge the route when assume Position B is Position A and decide to travel with the route that they remember (purple route). Hence, they could select the wrong route (red route). The situation associates to pedestrian experience bad wayfinding where he could loose by taking the wrong turn. As mentioned by some pedestrians which experience position error with landmark, square, jetty and special buildings;

"I have experience the situation when I take the wrong turn at Menara Condong because I am usually travel from other directions."

"Square looks similar from this direction with other direction which sometimes misinterpret the route."

"Sometimes, I misused the route when I travel at jetty from different directions. It happens when I think of something else."

"Yes, I experience it when I lost my focus when walking at The Store."

Human brain creates errors when encounter changes of viewpoint in different positions which cause by the angular displacement of the view frame and objects (Sulpizio et al., 2013). However, the finding identifies that pedestrians' recognition to the street features according to their experience when view from different positions reflects their wayfinding especially in deciding route. The situation occurs due to their concentration during perform the wayfinding when lost focus on

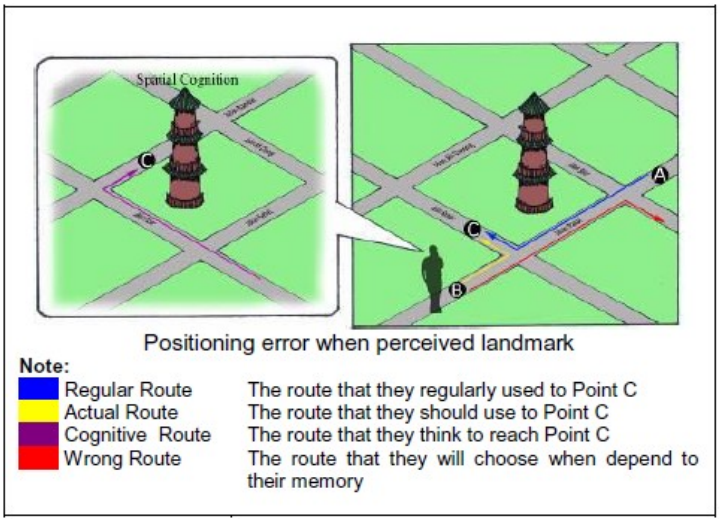


Figure 5 *Design duplication of walkways, stalls, and park confuses pedestrian to define route*

the route. Therefore, Factor B is defined and interpreted as error positioning when perceiving street features influence pedestrian wayfinding process in the street environment.

Lastly, three street features accumulated on Factor C, namely, shrubs (0.855), trees (0.809), and grassed area (0.748). The street features in Teluk Intan grow naturally while some were planted by local authority. The planting provide shade, cool the town, beautify the townscape, and create the sense of direction. However, similar species planted in different locations creates confusion to pedestrians. Pedestrians could misinterpret a location with another location when depends on a species of trees, shrubs or grass. The similar forms of trees, shrubs, or grass are in texture, color and size of flowers, fruits, leaves, and branches. Moreover, the planting changes when it grows. The changes on appearances make the environment harder for pedestrians to remember. For example, trees at Sekolah Street, Pterocarpus indicus (Angsana Tree), are similar with the trees at Changkat Jong Street. The similarity in green leaves, yellow flowers, and brownish trunk with huge form confuses pedestrian to define both streets (Figure 6a). A pedestrian commented that;

"I confuse with the trees because it look similar with other trees."

And the similarity also found at shrubs and grassed area (Figure 6b&c). For instance, some pedestrians said that about shrubs and grassed area;

"All shrubs look similar to me."

"I think both playfield look similar, huge and green."

The similarity in form of trees, shrubs and grassed area confuse pedestrian to define street with another street which planted by the similar species. The similarity of old and new information negatively influences pedestrian performance due to the overlapping information gained (Woollett and Maguire, 2010). But, the finding adds that the overlapping information from similarity forms of trees, shrubs and grassed area is created by its existence in different locations, not between old and new. Accordingly, trees, shrubs, grassed area, define and interpret Factor C as the similarity forms of the street features in influencing pedestrians to become unfamiliar with the street environments.

4. Conclusion

This paper found that three factors influence pedestrians to familiar with their route to the destinations. Firstly, the prominent characteristic of street features can influence pedestrian to recognize the route because the prominent character is easily to recognize and remember. Secondly, the street features which known as place of attraction by the locals such as landmark influence pedestrians to

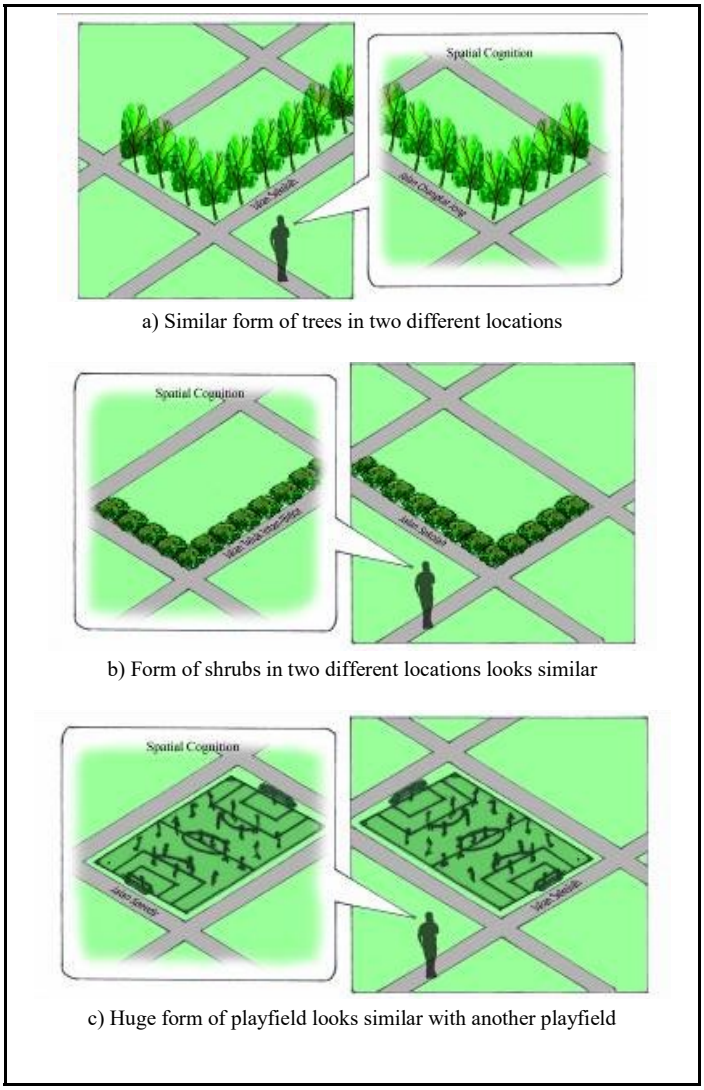


Figure 6 *The similarity in forms of trees, shrubs and grassed area confuse pedestrian with the street environment*

familiar with the street environment. Lastly, street features with the interesting elements can evoke pedestrians' attachment to the features which leads pedestrian to know more about the features.

Besides, this paper also indicates three factors influence pedestrians to unfamiliar with the street environment. Firstly, pedestrians are interrupted during wayfinding when encountered street features with design duplication in different locations. Secondly, pedestrians experience error when perceived street features in various positions. Lastly, pedestrian confuses to define route when encountered street features with similar forms from other locations.

Therefore, in providing environment for pedestrians to experience better wayfinding, a town requires to have street features that possess prominent characteristics, well-known street features as attractions places, or provided interesting elements. While, to reduces mistakes or lost during travel, the provided street features require to avoid possess duplication design of street features in different locations, various position on perceiving well known street features, or similarity forms of street features.

The street features are influential features to determine pedestrians' familiarity on the street environment. Accordingly, rigor investigation is required especially in defining the index of wayfinding for each street features. Therefore, studies on quality of street features to influence pedestrians' familiarity in wayfinding in small towns are recommended.

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