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The efficacy of campus wayfinding signage: A comparative study from Hong Kong and Pakistan

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Abstract

Purpose - Complex environments have a paucity of visual wayfinding information creating a strenuous situation for the new visitors. University campuses situated in the central urban areas with multi-storey structures and complex spatial layouts have poor environmental legibility. International students and visitors with diverse cultural backgrounds feel disoriented during wayfinding in these environments. This study aimed to investigate the cultural and individual differences affecting wayfinding behaviour.

Design/methodology/approach - An online wayfinding survey has been conducted through a questionnaire from 170 university students and visitors from Hong Kong and Pakistan. A five-point bipolar Likert scale has been used to evaluate wayfinding problems and ascribed behaviour.

Findings - The results enunciated a substantial influence of culture on the decision-making process and wayfinding behaviour. Critical differences have been documented based on the country of origin and native language. Individual related differences (age, gender, spatial familiarity, education, etc.) were computed, where age and spatial familiarity being noted as key factors impacting the respondents' opinion. Future exploration has been discussed for the pivotal elements regarding wayfinding information signage using computer simulations.

Research limitations/implications –The investigation can be further moved towards the other complex environments with fused facilities for a better understanding of wayfinding behaviour.

Practical implications – The findings can be instrumental for improved access to user facilities and can reinforce the user's trust and dependence on the institutional facility management.

Originality/value – In the wayfinding study, no cross-cultural (individualists vs collectivists) study have been conducted in a university campus to investigate the wayfinding difficulty and ascribed behaviour especially when the environment is unfamiliar.

Keywords: Wayfinding design, complex environment, cross-culture, environmental legibility, human behaviour

1- Introduction

Wayfinding in an environmental setting can be observed as the task of general navigation towards a particular destination (Ruddle and Lessels, 2006). It is considered as a thorough behaviour embodied by the tasks of searching, exploring, cognitive decisions, spatial learning and path planning from one place to the other by using environmental information. With the advent of technology, there have been elevated complexities in the building configurations, environmental setups and size of structures. As a ramification, wayfinding has been proved as a great matter of concern within an assemblage of buildings (Xie et al., 2009). The task of wayfinding can be aided with cues of environmental information that need to be processed concurrently (Wiener et al., 2009). The accumulated information is influential in building up a knowledge reservoir essential for requisite wayfinding tasks. A study (Norman, 1998) classified the knowledge into two further categories i.e. knowledge in the world and knowledge in the head. Knowledge in the world can be transformed into knowledge in the head by acquiring information from environmental cues and wayfinding aids. This knowledge can also only be obtained constructively by having direct real-time environment interaction (Krafft, 2001). During the wayfinding tasks, environmental knowledge has an important role in building the route plans, therefore, often referred to survey knowledge (Thorndyke and Hayes-Roth, 1982).

Spatial knowledge possesses critical importance for the navigator to avoid disorientation. An investigation (Wiener et al., 2009) has proposed three classifications of spatial information i.e. destination, route and environmental information. In addition to that, a study (Allen, 1999) found that wayfinding behaviour in a built environment can be strongly influenced by the wayfinding aids like signage, maps and portable navigation devices. According to the study (Lynch, 1960), the built environment bears two major qualities entitled as legibility and imageability. “Legibility” of an environment is concerned about the improved, comprehensive and effortless understanding of the environmental information (Golledge, 1999). Meanwhile “imageability” is the quality of an environmental object to be recalled in the observer’s mind with serenity and ease. Facile acquiring and escalated understanding of the spatial information can highly increase the environmental legibility (Abu-Ghazzeh, 1996). The supplement information and understanding of environmental settings have a significant influence on human wayfinding performance (O’Neill, 1992). A study (Gakopoulos, 2009) has proposed that the indoor built environment can be easy to navigate if the information on wayfinding signs are easy to understand. Consequently, a study (Afrooz, 2016) has suggested that environmental legibility can be increased with the intuitive design of visual cues. Landmarks like distinct building styles, sculptures, paintings and other recognizable environmental features can catalogue the spatial information in an organised disposition. These measures can make spatial settings more comprehensive for the navigators (Samany et al., 2008).

Mobile devices including cell phones, digital assistants, mobile tablets, smartwatches and smart glasses also provide the location-based information with the help of embedded GPS tracker. The GPS tracker is efficient enough to help in outdoor wayfinding with the help of designated roads, walkways and infrastructure. While indoor or institutional navigation, it cannot provide the synchronised wayfinding information with the institution due to the fused, shared and localised

nature of facilities. A study (Devlin, 2014) has investigated the role of mobile devices in outdoor wayfinding and found it instrumental. Although for indoor and complex outdoor environmental settings, the situation is a bit different due to the partial or complete unavailability of GPS signals. Researchers (Chumkamon and Keeratiwintakorn, 2008; Song, 2006; Willis, 2005) has designed the special beacon-based wayfinding system using radio frequency identification (RFID) to guide the mobile devices during indoor wayfinding. The approach was quite novel; however, it was still quite personalised as well as resource-demanding in comparison to the traditional wayfinding information systems i.e. signage. The personal mobile wayfinding systems require several constituents to deliver the wayfinding information effectively. The personal mobile device, guiding signals (GPS, RFID, Bluetooth etc.), digital literacy and user adaptability are some of the constituents. Apart from being resource-hungry in nature, the application of smart or digital wayfinding solutions requires a well-trained, equipped and digitally literate user (Silva et al., 2018). The critical factor in these scenarios is that the users need to digitally participate to find their way (Xue et al., 2019) making it impractical for masses.

University campuses can be defined as a complex environment for wayfinding due to complete or partial absence of designated pathways, low visual access and complex spatial layouts (Hidayetoglu et al., 2010). The buildings in institutional settings focus more on collective approach instead of an individualistic approach due to the shared facilities only possible by the interrelationships of buildings (Lindkvist et al., 2019). The shared, localised and fused nature of facilities makes a strenuous situation for users to decipher and memorise the spatial settings. The shared facilities offered inside a university campus with less distinctive spatial features makes the whole settings quite vulnerable to wayfinding problems. The study (Wiener et al., 2009) emphasizes that these wayfinding problems may be intensified if the user is a freshman and not familiar with the environmental settings. A study (Cheung, 2006) has identified the campus of Auckland University as a ‘homogenous environment’ because of complex and less distinctive spatial layout. The homogeneity of an environment is mainly dependent on the similarity in environmental features, lack of landmarks, absence of designated pathways and indistinguishable spatial layouts. The public sector or large university campuses have to offer several facilities to the students and staff members. These services consist of but not limited to campus administration, academics, sports, catering and hostels. The scattered availability of these services is necessary throughout the campus for effective and facile accessibility yet making the environment complex for wayfinding. A study (Passini, 1996) has indicated that the complications faced by an individual in orientation and sense of presence within an institution can impede the reputation of the respective institute and people’s opinion about that. A Study (O’Neill, 1991) has recommended that the improved wayfinding performance in a university campus can be established by a comprehensive redesigned signage systems. The effective information design on a signage system also improves the user’s access to the public facilities offered by the institution (Trisnawati and Sriwarno, 2018). Multiple investigations have suggested that wayfinding problems in the complex environments can cause some serious degree of stress, frustration and professional time loss (Arthur and Passini, 1992; Evans and McCoy, 1998). This can strongly impact the user’s cognitive

approach towards wayfinding and give them the impression of disorientation (Chang, 2013). Thus, the navigators particularly freshmen have a great chance of disorientation in these environmental settings.

In addition to spatial complexity, wayfinding tasks have a strong influence of cultural (Kinateder et al., 2014) and individual differences including gender (Gagnon et al., 2018), level of education (Hidayetoglu et al., 2012), profession, age (Lee et al., 2014), language and environmental familiarity (Marchette et al., 2011). Moreover, these differences can instigate the individual divergence ultimately affecting the human visual perception. Visual perception of environmental cues during wayfinding can be influential in behaviour diversity (Romera, 2015). There is a lack of investigative literature concerning international participants for the interpretation of wayfinding cues (Foster and Afzalnia, 2005) and information comprehension, particularly in complex environments. Along with the cultural differences, individual differences like age and gender are also considered to be instrumental in affecting wayfinding behaviour. Multiple studies (Davis et al., 2009; Mishra and Dasen, 2004; Taillade et al., 2013) have studied the age-related issues in wayfinding behaviour. In addition to that, studies (De Goede and Postma, 2015; Hund, 2016; Lovelace et al., 1999) have investigated the effects of gender on navigation strategy and performance within an indoor built environment. However, these studies lack the exploration of cultural and individual-related influences on wayfinding behaviour in complex campus environments.

2- Method

This study has been conducted through the online survey by the participants of Hong Kong and Pakistan (individualists and collectivists). This study aimed to investigate the cultural and individual differences influencing wayfinding behaviour. A five-point bipolar scale (strongly disagree as 1 to strongly agree as 5) have been used to record the participants' responses. The participants were mostly students or visitors of university campuses in Pakistan and Hong Kong. The university in Pakistan has a dedicated area of 60 hectares for its campus with more than 100 buildings consisting of academic departments, student hostels, libraries and other facilities. The spatial settings of the campus can be considered as a mixture of grid & radio centric layout planning. This university campus serves around 15000 students, more than 1000 faculty members and around 3000 employs. Eight percent of the total students are international students from. The international students mostly belong to the middle eastern regions, Africa and central Asia. While the university in Hong Kong has a dedicated campus area equivalent to 10 hectares with more than 25 high rise buildings. The campus has irregular spatial planning because of the number of planned extensions. This campus serves around 25000 local and 1000 international students. Many of the international students are from Europe, Africa, South America and Southeast Asia. The campus settings also accommodate approximately 5500 staff members. Both universities have complex spatial layouts involving fused facilities for students/staff, indistinguishable pathways, multi-level building access with compromised visual access to the wayfinding information. The participants

were invited to access the survey and record their responses through Google Forms. Ethical approval was obtained from the requisite authorities. The protocol was followed and consent was obtained by the participants for recording personal and demographic information.

2.1- Questionnaire design

The online questionnaire was focused to gather the information from participants based on three salient information categories illustrated in Table 1. The first segment embodied the questions related to personal and demographic information necessitate for the identification of cultural groups (Dasen, 2018; Furman et al., 2014; Gagnon et al., 2018). To distinguish cultural groups, the respondents were inquired about their country of origin, country of current residence and native language.

[Table 1 near here]

In addition to that, part of the questions was related to any international exposure acquired by living abroad as this can affect the indigenous cultural factors. Environmental familiarity has a strong influence on the participant's wayfinding behaviour, spatial understanding and wayfinding performance (Hegarty et al., 2002; Nori and Piccardi, 2010). Therefore, questions in the second segment were concerned about the participant's spatial familiarity of the campus. The impression was acquired by asking the participant's nature and frequency of the campus visit along with the landmark familiarity. Based on the information gathered, the participants have been asked to self-report their level of environmental familiarity. The five-point reporting scale was used to record their answers (not familiar as 1 to very familiar as 5). Consequently, the groups were segregated into two major categories i.e. participants with lower familiarity (1 to 3) and with higher familiarity (4 to 5).

The final segment of the questionnaire incorporated the questions related to wayfinding problems in information gathering. These questions were framed to investigate the encountered problems, whether the problems existed in the information retrieval from wayfinding aids or in the understanding of spatial layouts. The questions were asked in a random order for obtaining the participant's natural response. The thirty questions were designed to investigate the navigator's probable behaviour while experiencing wayfinding difficulties. As the factors exploring wayfinding behaviour comprised of environmental information aids, perception about the information and ascribed actions after gathering the information (Hegarty et al., 2006; Montello, 2001).

2.2- Data collection

The students or general campus navigators have participated in this study from Hong Kong and Pakistan (individualists and collectivists) respectively. Both universities have been considered high ranked institutions in their respective locations, attracting students and visitors from across

the country. The respondents can be taken as an optimal sample because of their belongings from diverse areas of the respective country having core cultural homogeneity. In totality, 203 individuals from the different parts of Hong Kong and Pakistan have participated in the campus wayfinding study. Amongst 203 participants, 170 were considered suitable as they mentioned their country of origin either Hong Kong or Pakistan. The chosen respondents were either freshman students or general campus visitors having a mediocre or low level of environmental familiarity. The selected language for the survey was English as it was equally understandable in both universities although much wayfinding information is available in bilingual medium (Urdu-English for Pakistan, Cantonese-English for Hong Kong). To minimize the confounding factors regarding the cultural association, while maintaining unique individual diversities, the responses were gathered by those participants having minimal international or cross-cultural exposure. Additionally, the education level was kept from below undergraduate to postgraduate level & above along with the age group from 18 years to 37 years.

2.3- Data analysis

Responses were collected through the online services of google forms followed by a screening process based on the completion of information. Participants from Hong Kong and mainland China were considered in the same cultural category. For cross-cultural comparison, respondents having the country of origin other than Hong Kong, mainland China and Pakistan were excluded from the questionnaire analysis. The screened data was imported into Microsoft Excel for initial descriptive statistics and processed afterwards for statistical analysis using SPSS software.

Subsequently, the data was imported in SPSS software for further analysis for normality check. By the application of the Shapiro-Wilk test, the data for analysis was found non-normally distributed. Therefore, non-parametric tests have been applied based on the respective independent group size. As the collected data was in the form of five-point bipolar Likert scale, therefore, it was recognised as ordinal scale data. For correlating two independent groups, the Mann-Whitney U test (Nachar, 2008) has been applied. In addition to that, the comparison of more than two independent groups has been investigated by the application of the Kruskal-Wallis test (Corder and Foreman, 2009) followed by the respective correlation tests. The independent sample groups were formed based on the cultural differences (country of origin) and individual differences (gender, age, level of education and the level of environmental familiarity).

3- Results

[Table 2 near here]

For the questionnaire analysis, an inclusion criterion was established based on the participant's demographic information and completion of the survey form. A total of 170 questionnaires out of 203 (83.74%) were found appropriate for incorporating in further analysis.

3.1- General demographics

The initial descriptive statistics enunciated that 55% and 45% of the responses were recorded from Hong Kong and Pakistan respectively. Moreover, a quite similar ratio has also been observed for the gender of participants, the females were at 55% and males at 45%. The participants were asked about their respective ages as it has been considered an influential factor in previous wayfinding behaviour investigation (Lin et al., 2019). The respondents were further segregated into four age groups five years apart starting from 18 years to 37 years as presented in Table 2. The last two age groups from 28 years to 37 years have been combined due to the smaller number of participants for maintaining the reliability of results. Majority of the participants across the groups (82%) were in between 18 years to 27 years while the rest of the participants (18%) were from age 28 to 37 years. Concerning the level of education, half of the total participants were undergraduates and the remaining were postgraduate & above. Most participants were students (92%) while some of them were general visitors (8%) of university campuses.

3.2- Cultural differences

For the collation of both cultural groups (Hong Kong and Pakistan), a non-parametric test (Mann Whitney U test) was considered appropriate for the analysis. Total twelve number of questions were significantly different (p <0.05), mostly related to wayfinding signage and information available on it. The participants from Hong Kong have faced difficulty in understanding the wayfinding information through signage as compared to the Pakistani participants. The higher mean (3.52) and significant value (p = 0.032) of Q6 has been recorded for Pakistani participants as compared to the Hong Kong group. Signage information was easy to understand for Pakistani participants as compared to the other group. For the participants of Hong Kong, people were more confused in looking for environmental information and find it less useful for navigation inside the university campus. The reliance on the provided information was also poor in the respondents from Hong Kong.

[Table 3 near here]

The participants from Pakistan considered access to information through environmental cues relatively easy than the participants from Hong Kong. Both institutions are using standardised wayfinding signage having bilingual information on it. The standardised signage design consisted of recommended fonts, spaces and symbols. Pakistani participants have identified the abundance of details as a problem in information visibility, access and comprehension. While participants from Hong Kong haven't identified this factor of such importance (p = 0.004) as reflected for Q24 in Table 3 and Figure 1. Participants from Pakistan prefer bilingual signage along with the graphical information. The difference of opinion was found significant for Q28, Q29 and Q30 having p values 0.020, 0.013 and 0.002 respectively.

[Figure 1 near here]

The Pakistani individuals felt comfortable and relied more on verbal directions than the other cultural group despite the presence of signage information. Due to the lack of social interactions, the people in Hong Kong were more hesitant to ask directions and solely tried to resolve the wayfinding problems on their own as depicted in the mean comparison of Q9 (Hong Kong, 2.85; Pakistan, 3.45) having significant p-value (p = 0.001). This behaviour of self-dependence of Hong Kong participants is quite similar to the individualistic society while considering the other group as a collectivist society. The nomenclature of this segregation (individualistic and collectivist society) has also been found operative in a similar study (Asghar et al., 2019). The comparison of the Mean value of both cultural groups has also depicted that the level of environmental familiarity is quite higher in Pakistani participants due to ample environmental knowledge from signage and verbal directions. Consequently, the need for wayfinding information is quite necessary for the participants from Hong Kong as they are not able to identify and memorise the selective locations inside the campus due to complex spatial planning. These results can easily be seen in the mean and standard deviation comparison of Q13 and Q14 respectively.

3.3- Environmental familiarity

For this study, the participants have been segregated into two groups with a high and low level of environmental familiarity. Participants were asked different locations on their campus to identify and with the provided data they have been allotted the respective group for further analysis. 39% of participants were found with a low environmental familiarity while 61% of the participants were found with a higher level of familiarity.

To evaluate these responses, Mann Whitney U test has been applied for the statistical analysis as the groups were considered as two independent samples. As depicted in Table 4, an ample amount of statistically significant responses has been recorded regarding the comprehension of environmental information. The difference in mean values of Q6 (Low, 3.06; High, 3.51) with the p = 0.000 has depicted the issues in understanding the environmental information for the participants with a low level of familiarity. This problem has a strong impact on understanding the spatial environment which can decrease their confidence to find the required destination. For that reason, the participants from both groups need to rely on the information cues for directed wayfinding tasks as mean values of responses Q11 suggested (Low, 3.06; High, 3.81).

[Table 4 near here]

Despite being low in environmental knowledge, the participants have less preference for asking directions verbally. On the contrary participants with high EF are more comfortable in making social interactions and are more comfortable in asking about the unknown destination from a passer-by. Being familiar with the environment, participants have responded positively about the presence of wayfinding issues in their respective campuses. This finding can also depict that the difficulties in memorising the spatial environment exist due to the absence of distinctive spatial

features and landmarks. Therefore, the group with high EF didn't respond strongly in the favour of completely knowing and memorising the environment as described by their mean values for Q16 (Low EF, 2.72; high EF, 3.66) although they have a significant difference of behaviour with a competitive group ($p = 0.000$).

[Figure 2 near here]

The participants with low EF found it quite difficult in viewing their directions on mobile devices in the form of interactive maps as well as YAH (you are here) maps. On the other hand, the $p = 0.000$ for Q19 have shown that the information on these devices can be deciphered easily by the participants with high EF due to the presence of corresponding cognitive mapping and memory nodes. Concerning the information, the contradictions have also appeared regarding the minimal and detailed information on environmental wayfinding cues as shown in Figure 2 specifically in last questions (Q30). The low EF participants have responded in favour of detailed information presence (multilingual, pictograms and symbols etc.). On the contrary, a great inclination has been shown by the other group towards minimal information presence on environmental cues. Significant differences have been recorded by the participants having *p*-values 0.017, 0.002, 0.008 for Q24, Q29, and Q30 respectively regarding the volume of information.

3.4- Individual differences

Two groups were formed based on the gender segregation, and Man Whitney U test has been applied for the group based on these two independent samples. The study explored some of the significant contradictions as depicted in Table 5 along with the graphical representation in Figure 3. Based on gender, the study found that female respondents have experienced difficulties regarding wayfinding within the university campus. The signage information was quite misleading and difficult to comprehend for them to find information about their respective destination. On the contrary, males have experienced fewer problems in campus wayfinding, however, they also found environmental information difficult to understand. Significant *p*-values (0.020, 0.002 and 0.017) for Q1, Q7 and Q8 respectively have been recorded for the said problems amongst these groups. Females were found more socially active than males while asking and telling directions to the passer-by.

[Table 5 near here]

For further exploration, the collected data was gathered into four age groups having five years of difference starting from 18 years till 37 years to check the influences of age difference on wayfinding behaviour. Due to a smaller number of participants, the last two groups (28-32, 33-37) were merged for maintaining the reliability of the statistical analysis. Most of the responses were recorded from the first two groups being at 40% and 41% respectively. As there were three independent samples for this group, the Kruskal Wallis test was considered appropriate for the

statistical analysis of this non-parametric ordinal data (Corder and Foreman, 2009; Kruskal and Wallis, 1952). No significant differences across different ages have been recorded.

[Figure 3 near here]

In addition to the age-related differences, another influencing factor was the education background. The gathered data was classified into 2 main categories consisting of undergraduates along with the second category of postgraduates & above. Both groups have similar numbers of participants. Being two independent group samples, Man Whitney U test was selected for the statistical analysis. The influence of the level of education has not been significant enough in most of the questions regarding wayfinding behaviour. However, there were some insights which may explore their behaviour in detail. In comparison to the first group, the group with higher education status have reflected a significant interest in looking for wayfinding information in the environment while feeling spatial planning as the complex one. Amongst the two groups, the significant *p*-values for both questions regarding information searching and the complex spatial planning were 0.007 and 0.012 respectively. For the rest of the questions, the results have not shown any significant differences.

3.5- Correlation analysis

Furthermore, the gathered data has been analysed for correlation by applying the Kendall tau's correlation test as demonstrated in Table 6. The correlation test has provided interesting insights for campus wayfinding based on the user's behaviour, perception and preferences. The respondents have expressed the difficulty in the understanding of wayfinding signage as they are misleading sometimes. The high value of the correlation coefficient for Q7 and Q8 (0.598) has indicated that the signage legibility becomes poor when the environment has complex settings and intricate layout planning. This inference has been backed up with the correlation coefficient of Q10 (0.401) with Q8 where the reason is associated with the spatial complexity.

[Table 6 near here]

A strong interrelation has also been found in the placement of signage and visitor's interaction with them. This interaction indicates that signage placement and noticeability may not be the cause of disorientation on campus. Respondents have expressed this notion in the correlation of Q17 with Q12 and Q18 with Q12, where people tend to use other sources of environmental knowledge like mobile phones due to the insufficiency of the available information on signage. However, mobile devices are not helpful enough for the wayfinders due to the lack of correlation between wayfinding aids and the real environment. Individuals also tend to ask directions from the passer-by to gain environmental knowledge and comfortable enough to tell the directions once they reach enough level of information. This finding has been inferred from the correlation of Q20 with Q9, Q11, Q14, Q15, Q16, Q17 and Q19 respectively which further expressed the professional time loss of the navigators along with the poor information delivery of campus signage.

4- Discussion

In the individualistic cultures, several behavioural properties have been dominant including independence and autonomy. On the contrary, the collectivist cultures emphasize more on social interaction, interdependence and communal obedience (Yaman et al., 2010). Hong Kong has an influence from western culture due to which bilingual Hong Kong participants can be considered close to an individualistic society (Ralston et al., 1995). On the other hand, Pakistan being influenced by collective culture can be observed as a collectivist society due to strong social relationships and interdependence (Asghar et al., 2018, 2019). For the present study, significant cultural influences have been observed in wayfinding behaviours for both cultural groups.

The participants from Pakistan faced difficulties in navigation on campus but they tried to overcome this issue by using the social interactions in getting verbal wayfinding information (Ahmed, 2015). The social interactions were found influential on wayfinding behaviour and performance consistent with the previous research (Chebat and Slusarczyk, 2005; Hund et al., 2012). The Pakistani participants have preferred the simple, less tangled and minimal design for the wayfinding information. This preference can be linked with the cultural quality of interdependence in collectivist societies. This behaviour of synthesizing the visual and verbal information put less pressure on the participants to look for detailed information on wayfinding design. Conversely, the participants from Hong Kong have depicted more individualistic behaviour in obtaining wayfinding information. This behavioural pattern can be well justified by their cultural thinking of being autonomous and independent. The society with such qualities is quite hesitant in asking for help for finding their desired location. Because of that, the wayfinding information design needs to be detailed in providing environmental and directional information. Due to both verbal and visual information gathering for Pakistani participants, it is relatively easy to enhance spatial familiarity. While other group still needs to rely on the visual information to effectively map the required destination. Another significant difference in culture has been spotted in the preference for symbolic and textual information. The participants from Hong Kong preferred the detailed textual information over the symbolic information. The reason is that they find it difficult to understand and comprehend the meaning behind it in comparison to the written text.

In complex environmental settings, environmental familiarity is quite difficult to achieve. Consequently, raising the need for detailed wayfinding information of spatial layout. Once the spatial familiarity has been developed, the wayfinding performance and behaviour significantly improved. Many studies (Li and Klippel, 2012; Mallot, 1999; Marchette et al., 2011; Sholl et al., 2006) have observed such influences on wayfinding behaviour. The present study has observed similar findings in complex university settings. However, participants found it hard to achieve spatial familiarity due to the complex planning and layout of the campus. The participants having a low level of environmental familiarity have faced extensive problems in roaming around the campus. With the low environmental information in the head, the participants must rely on signage information rather than memorising the spatial features (landmarks, route etc.). While having

complications in comprehending the wayfinding information, the group has elevated frustration, time loss and confusion. Due to less exposure to the environmental surroundings, complex spatial planning and diffused spaces, the campus environment has been identified as challenging to be familiar and legible consistent with the previous study (Cheung, 2006).

Gender differences have been identified arguably as an influential factor in previous literature (Gagnon et al., 2018; Waller, 2000). For our study, the females have faced more difficulties in wayfinding on campus due to poor comprehension of signage information. To overcome the mentioned problem female participants have relied more on the verbal directions rather than gathering information through dedicated cues. A significant gender difference has been recorded for Q7 ($p = 0.002$) by considering the environmental information misleading. Conversely, males outperformed females in signage information comprehension. Due to this fact, they faced fewer problems in wayfinding in comparison to females. The present study didn't find any significant difference in behaviour for the age groups. The finding was considered quite contrasting to the studies (Head and Isom, 2010; Jansen-Osmann and Fuchs, 2006; Jansen et al., 2010) where the difference of age has indicated a strong impact. The reason for such finding may be due to the smaller difference (5 years) in between the age groups. Whereas in the prior studies (Lee et al., 2014; Taillade et al., 2013), the age gaps between the participants were comparatively larger (> 15 years) to identify the difference. In addition to that, the level of education was considered another influential factor in the previous study (Morley and Cobbett, 1997). No significant impacts of education level have been observed on wayfinding behaviour, possibly due to the less significant difference in education level between the groups.

With reference to the above study, certain limitations have been observed for the generalization of the current findings. The sample population mostly have university students while fewer of the participants were general visitors. The finding can be applied to the newcomers of the mentioned regions but for the navigation of general visitors, the results may have some constraints. An additional factor is the presence of a larger crowd in the university in Hong Kong as compared to the university in Pakistan. Due to the fact, the wayfinding behaviour may be affected as visual access and ability to comprehend the information is affected.

5- Conclusions

While considering the university campus as a complex environment for wayfinding, the aim was to identify the potential cultural and individual impacts on wayfinding behaviour. Moreover, the finding can be influential in enhancing the efficiency of campus wayfinding for freshmen and general visitors to mitigate an individual's time losses, disorientation along with the consequent stress and frustration. Being the exploratory study in nature, certain parameters for the wayfinding issues have been identified in the review of the literature and presented before conducting the study. The identified influential factors were complex spatial planning, cultural

differences, environmental familiarity, gender, age and the level of education. Cultural difference has been identified as a key factor in varied wayfinding behaviour amongst the groups.

Cross-cultural differences in wayfinding behaviour have been recorded for environmental information gathering, signage understanding and environmental familiarity. The participants from Hong Kong although being familiar with the environment relied more on the environmental information through signage as compared to the Pakistani group. The participants from Pakistan have acquired environmental knowledge through verbal communication as well as signage information. Significant effects of environmental familiarity have been recorded on wayfinding behaviour, however, no significant results have been obtained for the differences in age and the level of education. The participants who were familiar with the environment relied more on their cognitive memory instead of signage information for wayfinding.

Moreover, it has been found difficult for the participants to memorise the whole environment if there is a higher level of complexity in spatial layout. For the complex university environment, a signage design with appropriate and easy to comprehend wayfinding information is recommended though differentiating enough from the visual clutter. The efficient signage system should be developed based on culturally consistent textual and graphical information to intuitively direct the navigators to their desired way. In addition to that, the gender difference was slightly influential in affecting wayfinding behaviour. In the subsequent section of the research article, potential limitations have been discussed for the generalizability of the mentioned findings. Certain factors have been found influential in the wayfinding research including but not limited to spatial layout complexity as well as obtaining environmental information through signage.

The current study has indicated that the wayfinding and leisure navigation in a complex environment is not an easy task in comparison to the places where visible spatial cues are present. The dense spatial layouts with complex and fused nature of facilities need an effective way of delivering environmental information to the users. The traditional standardised signage is relatively insufficient in providing the complete, comprehensive and effective wayfinding information. The ease of wayfinding is not beneficial for the users only but it can also improve the access to the institutional facilities. The present study had provided more focus on traditional wayfinding information medium than the modern wayfinding solutions e.g. mobile devices. Modern solutions of wayfinding based on mobile devices are resource hungry as well as providing generalised information. There is a need to synthesise both information mediums for effective wayfinding information design. The synthesised wayfinding information has the potential to facilitate the user wayfinding, general navigation and access to the campus facilities. For further exploration of the said factors, it is therefore recommended to conduct future studies in the form of user-based experiments by having real-time and immersive virtual environments. Further research can be instrumental in making university campuses as an efficient and legible environment for wayfinding.

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Table 1 Questionnaire design

I- Demographic/Personal information questions	**II- Environmental Familiarity (EF) questions**
Gender	Nature of campus visit
Age	Visiting frequency
Level of education	Location Identification
Country of origin/residence	Environmental Familiarity level
Native language	
International exposure	
III- **Wayfinding signage information questions**	
Q1. In the beginning campus wayfinding was difficult.	Q16. Spatially quite familiar.
Q2. In the beginning I get disoriented on campus.	Q17. I have seen many disoriented visitors.
Q3. I always find my way through signage.	Q18. People use mobile devices for wayfinding.
Q4. I always look for wayfinding signage.	Q19. Signage are easy than cell phone.
Q5. For wayfinding I had to memorize the locations.	Q20. I usually tell directions to new visitors.
Q6. Signage information is easy to understand.	Q21. Campus is too complex.
Q7. Campus signs are misleading sometimes.	Q22. I always tell directions through signage.
Q8. Campus signs are difficult to read.	Q23. Signage should follow university theme.
Q 9. I ask directions from passerby.	Q24. Signage should be simple and minimal.
Q10. Campus planning is very complex.	Q25. Signage info. should be detailed.
Q11. Can find destination without signage.	Q26. Signage design should represent institute.
Q12. Signage is noticeable on campus.	Q27. Colour coded info. Should be available.
Q13. Signage information is only for freshman.	Q28. Dual language signage is confusing.
Q14. Familiar with campus planning.	Q29. Signage should always have pictograms.
Q15. Prefer verbal directions for wayfinding.	Q30. Pictograms/symbols are easy to understand.

Table 2 Participants summary

	Hong Kong	**Pakistan**	***Total***
Gender			
Female	51	41	92
Male	42	36	78
Total	**93**	**77**	**170**
Age Group			
18-22	31	38	69
23-27	42	28	70
28-37	20	11	31
Total	**93**	**77**	**170**
Education Level			
Undergraduate	35	50	85
Postgraduate & above	58	27	85
Total	**93**	**77**	**170**
Environmental Familiarity Level			
Low	48	19	67
High	45	58	103
Total	**93**	**77**	**170**

Table 3 Cross-cultural comparison of groups

Q no.	**Question Description**	**HONG KONG**				**PAKISTAN**				***p*-value**
		Min	*Max*	*Mean*	*S.D.*	*Min*	*Max*	*Mean*	*S.D.*	
1	Campus wayfinding was difficult in starting.	1	5	3.33	1.27	1	5	3.69	1.22	0.074
2	In the beginning I get disoriented on campus.	1	5	3.26	1.14	1	5	3.29	1.22	0.805
3	I always find my way through signage.	1	5	3.31	1.30	1	5	3.32	1.23	0.999
4	Signage information is helpful.	1	5	3.24	1.12	1	5	3.09	1.33	0.473
5	need to memorise the locations.	1	5	3.32	1.10	1	5	3.61	1.16	0.079
6	Signage information is easy to understand.	1	5	3.18	0.95	1	5	3.52	1.21	**0.032***
7	Campus signs are misleading sometimes.	1	5	3.01	1.07	1	5	2.87	1.18	0.565
8	Campus signs are difficult to read.	1	5	2.72	1.06	1	5	2.77	1.07	0.749
9	I ask directions from passer-by.	1	5	2.85	1.15	1	5	3.45	1.31	**0.001***
10	Campus planning is very complex.	1	5	2.94	1.05	1	5	2.86	1.14	0.586
11	Can find destination without signage.	1	5	3.25	1.32	1	5	3.83	1.33	**0.003***
12	Signage is noticeable on campus.	1	5	3.23	1.01	1	5	3.26	1.14	0.904
13	Signage information is only for freshman.	1	5	2.83	1.19	1	5	3.27	1.25	**0.019***
14	Familiar with campus planning.	1	5	2.90	1.19	1	5	3.51	1.31	**0.002***
15	Prefer verbal directions for wayfinding.	1	5	2.81	1.24	1	5	3.06	1.14	0.159
16	Spatially quite familiar.	1	5	2.99	1.25	1	5	3.65	1.14	**0.001***
17	I have seen many disoriented visitors.	1	5	3.23	1.21	1	5	3.23	1.06	0.883
18	People use mobile devices for wayfinding.	1	5	3.02	1.11	1	5	2.97	1.14	0.880
19	Signage are easy than cell phone.	1	5	3.02	1.15	1	5	3.35	1.09	0.055
20	I usually tell directions to new visitors.	1	5	3.01	1.06	1	5	3.79	1.07	**0.000***
21	Campus is too complex.	1	5	2.82	1.17	1	5	2.97	1.28	0.440
22	I always tell directions through signage.	1	5	2.91	1.07	1	5	2.90	1.12	0.883
23	Signage should follow university theme.	1	5	3.14	1.14	1	5	3.19	1.23	0.760
24	Signage should be simple and minimal.	1	5	3.43	1.33	1	5	3.99	1.19	**0.004***
25	Signage info. should be detailed.	1	5	3.15	1.09	1	5	3.26	1.23	0.558
26	Signage design should represent institute.	1	5	3.15	1.13	1	5	3.73	1.08	**0.002***
27	Colour coded info. Should be available.	1	5	3.42	1.17	1	5	3.77	1.11	0.058
28	Dual language signage is confusing.	1	5	2.70	1.23	1	5	3.14	1.16	**0.020***
29	Signage should always have pictograms.	1	5	3.25	1.11	1	5	3.68	1.11	**0.013***
30	Pictograms/symbols are easy to understand.	1	5	3.24	1.14	1	5	3.78	1.22	**0.002***

p < 0.05 for Mann-Whitney U Test

Table 4 Comparison of Environmental familiarity (EF) level

Q no.	**Question Description**	**Familiarity Level (Low)**				**Familiarity Level (High)**				***p*-value**
		Min	*Max*	*Mean*	*S.D.*	*Min*	*Max*	*Mean*	*S.D.*	
1	Campus wayfinding was difficult in starting.	1	5	3.42	1.28	1	5	3.54	1.24	0.434
2	In the beginning I get disoriented on campus.	1	5	3.18	1.18	1	5	3.33	1.17	0.249
3	I always find my way through signage.	1	5	3.52	1.16	1	5	3.18	1.32	0.229
4	Signage information is helpful.	1	5	3.27	1.08	1	5	3.11	1.30	0.520
5	need to memorise the locations.	1	5	3.36	1.16	1	5	3.51	1.12	0.198
6	Signage information is easy to understand.	1	5	3.06	0.94	1	5	3.51	1.15	**0.000***
7	Campus signs are misleading sometimes.	1	5	3.01	1.12	1	5	2.90	1.12	0.332
8	Campus signs are difficult to read.	1	5	2.75	1.09	1	5	2.74	1.05	0.436
9	I ask directions from passer-by.	1	5	2.90	1.21	1	5	3.27	1.28	0.137
10	Campus planning is very complex.	1	5	2.97	1.09	1	5	2.85	1.10	0.504
11	Can find destination without signage.	1	5	3.06	1.31	1	5	3.81	1.31	**0.000***
12	Signage is noticeable on campus.	1	5	3.18	1.04	1	5	3.28	1.09	0.673
13	Signage information is only for freshman.	1	5	2.66	1.15	1	5	3.27	1.23	**0.007***
14	Familiar with campus planning.	1	5	2.67	1.20	1	5	3.50	1.23	**0.000***
15	Prefer verbal directions for wayfinding.	1	5	2.63	1.23	1	5	3.12	1.15	**0.009***
16	Spatially quite familiar.	1	5	2.72	1.14	1	5	3.66	1.17	**0.000***
17	I have seen many disoriented visitors.	1	5	2.97	1.09	1	5	3.40	1.15	**0.012***
18	People use mobile devices for wayfinding.	1	5	2.96	1.15	1	5	3.03	1.11	0.994
19	Signage are easy than cell phone.	1	5	2.78	1.04	1	5	3.43	1.12	**0.000***
20	I usually tell directions to new visitors.	1	5	2.94	1.07	1	5	3.64	1.08	**0.000***
21	Campus is too complex.	1	5	2.94	1.27	1	5	2.85	1.19	0.270
22	I always tell directions through signage.	1	5	2.82	1.07	1	5	2.96	1.10	0.814
23	Signage should follow university theme.	1	5	3.03	1.18	1	5	3.25	1.17	0.559
24	Signage should be simple and minimal.	1	5	3.43	1.32	1	5	3.84	1.26	**0.017***
25	Signage info. should be detailed.	1	5	3.00	1.13	1	5	3.33	1.16	**0.029***
26	Signage design should represent institute.	1	5	3.15	1.13	1	5	3.58	1.12	0.104
27	Colour coded info. Should be available.	1	5	3.37	1.17	1	5	3.71	1.13	0.080
28	Dual language signage is confusing.	1	5	2.78	1.17	1	5	2.98	1.24	0.653
29	Signage should always have pictograms.	1	5	3.13	1.14	1	5	3.64	1.07	**0.002***
30	Pictograms/symbols are easy to understand.	1	5	3.19	1.21	1	5	3.67	1.17	**0.008***

p < *0.05 for Mann-Whitney U Test

Table 5 Comparison of Gender

Q no.	**Question Description**	**Male**				**Female**				***p*-value**
		Min	*Max*	*Mean*	*S.D.*	*Min*	*Max*	*Mean*	*S.D.*	
1	Campus wayfinding was difficult in starting.	1	5	3.19	1.31	1	5	3.75	1.15	**0.020***
2	In the beginning I get disoriented on campus.	1	5	3.04	1.16	1	5	3.47	1.16	0.064
3	I always find my way through signage.	1	5	3.24	1.22	1	5	3.38	1.31	0.535
4	Signage information is helpful.	1	5	3.17	1.13	1	5	3.17	1.29	0.687
5	need to memorise the locations.	1	5	3.40	1.10	1	5	3.50	1.17	0.213
6	Signage information is easy to understand.	1	5	3.38	1.11	1	5	3.29	1.07	0.194
7	Campus signs are misleading sometimes.	1	5	2.73	1.10	1	5	3.13	1.11	**0.002***
8	Campus signs are difficult to read.	1	5	2.62	1.06	1	5	2.85	1.06	**0.017***
9	I ask directions from passer-by.	1	5	2.78	1.19	1	5	3.41	1.25	**0.001***
10	Campus planning is very complex.	1	5	2.78	1.18	1	5	3.00	1.01	0.134
11	Can find destination without signage.	1	5	3.28	1.41	1	5	3.71	1.28	**0.045***
12	Signage is noticeable on campus.	1	5	3.24	1.10	1	5	3.24	1.05	0.807
13	Signage information is only for freshman.	1	5	2.99	1.26	1	5	3.07	1.21	0.418
14	Familiar with campus planning.	1	5	3.04	1.28	1	5	3.29	1.27	0.147
15	Prefer verbal directions for wayfinding.	1	5	2.88	1.23	1	5	2.96	1.19	0.801
16	Spatially quite familiar.	1	5	3.12	1.26	1	5	3.43	1.22	0.089
17	I have seen many disoriented visitors.	1	5	3.13	1.19	1	5	3.32	1.10	0.425
18	People use mobile devices for wayfinding.	1	5	2.87	1.12	1	5	3.11	1.11	0.312
19	Signage are easy than cell phone.	1	5	2.99	1.18	1	5	3.33	1.07	0.245
20	I usually tell directions to new visitors.	1	5	3.15	1.15	1	5	3.54	1.08	**0.046***
21	Campus is too complex.	1	5	2.90	1.21	1	5	2.88	1.23	0.826
22	I always tell directions through signage.	1	5	2.91	1.16	1	5	2.90	1.03	0.437
23	Signage should follow university theme.	1	5	3.21	1.26	1	5	3.13	1.10	0.532
24	Signage should be simple and minimal.	1	5	3.60	1.34	1	5	3.75	1.25	0.335
25	Signage info. should be detailed.	1	5	3.22	1.20	1	5	3.18	1.12	0.690
26	Signage design should represent institute.	1	5	3.33	1.12	1	5	3.48	1.16	0.482
27	Colour coded info. Should be available.	1	5	3.49	1.22	1	5	3.65	1.09	0.857
28	Dual language signage is confusing.	1	5	2.82	1.21	1	5	2.97	1.22	0.583
29	Signage should always have pictograms.	1	5	3.37	1.13	1	5	3.50	1.12	0.302
30	Pictograms/symbols are easy to understand.	1	5	3.41	1.28	1	5	3.54	1.13	0.350

p < 0.05 for Mann-Whitney U Test

Table 6 Kendall tau's correlation test

Sr.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	1.000																													
2	**0.610****																													
3	0.369**	0.325**																												
4	0.207**	0.270**	0.507**																											
5	0.312**	0.268**	0.142*	0.165**																										
6	0.174**	0.097	0.273**	0.321**	0.163**																									
7	0.275**	0.299**	0.299**	0.254**	0.233**	-0.037																								
8	0.248**	0.277**	0.160**	0.093	0.271**	-0.142*	**0.598****																							
9	0.282**	0.279**	0.195**	0.098	0.187**	0.136*	0.263**	0.257**																						
10	0.290**	0.328**	0.177**	0.154**	0.272**	-0.017	**0.379****	**0.401****	0.273**																					
11	0.333**	0.268**	0.081	0.025	0.315**	0.272**	0.093	0.081	0.329**	0.134*																				
12	0.153**	0.126*	0.243**	0.319**	0.172**	0.413**	0.117*	-0.029	0.109	0.066	0.280**																			
13	0.171**	0.085	0.042	0.036	0.201**	0.177**	0.066	0.109	0.189**	0.102	**0.351****	0.208**																		
14	0.130*	0.100	-0.104	-0.095	0.226**	0.172**	0.078	0.181**	0.294**	0.085	**0.476****	0.163**	0.504**																	
15	0.096	0.038	-0.029	0.042	0.144*	0.143*	0.055	0.071	0.346**	0.123*	0.251**	0.177**	0.148**	0.265**																
16	0.141*	0.068	-0.033	-0.060	0.281**	0.222**	0.012	0.060	0.178**	0.018	**0.459****	0.208**	0.440**	**0.559****	0.233**															
17	0.206**	0.128*	0.244**	0.273**	0.296**	0.199**	0.244**	0.163**	0.160**	0.167**	0.261**	**0.354****	0.261**	0.169**	0.207**	0.260**														
18	0.162**	0.096	0.225**	0.215**	0.222**	0.152**	0.275**	0.212**	0.123*	0.240**	0.139*	**0.326****	0.194**	0.154**	0.133*	0.113	**0.412****													
19	0.185**	0.140*	0.142*	0.157**	0.152**	0.247**	0.208**	0.169**	0.157**	0.190**	0.264**	0.269**	0.230**	0.231**	0.152**	0.257**	0.277**	0.322**												
20	0.274**	0.218**	0.054	0.017	0.239**	0.168**	0.188**	0.175**	**0.411****	0.258**	**0.452****	0.185**	0.289**	**0.357****	**0.316****	**0.402****	**0.328****	0.222**	**0.390****											
21	**0.331****	**0.302****	0.252**	0.198**	0.110	0.028	0.289**	0.256**	0.229**	**0.391****	0.081	0.155**	0.114*	0.088	0.130*	-0.039	0.162**	**0.344****	0.168**	0.174**										
22	0.127*	0.136*	0.262**	0.290**	0.026	0.169**	0.202**	0.158**	0.119*	0.170**	0.077	**0.366****	0.225**	0.104	0.155**	0.083	0.228**	**0.326****	**0.331****	0.146*	0.259**									
23	0.147*	0.119*	0.117*	0.158**	0.149**	0.182**	0.163**	0.150**	0.099	0.149*	0.193**	0.207**	0.207**	0.270**	0.108	0.226**	0.244**	**0.295****	0.297**	0.232**	0.268**	0.259**								
24	0.298**	0.134*	0.214**	0.199**	0.293**	0.253**	0.130*	0.134*	0.246**	0.150**	**0.360****	0.226**	**0.349****	0.293**	0.228**	**0.336****	0.251**	0.238**	0.265**	**0.364****	0.187**	0.183**	**0.305****							
25	0.186**	0.185**	0.159**	0.287**	0.224**	0.255**	0.158**	0.142*	0.137*	0.165**	**0.291****	0.272**	0.258**	0.265**	0.243**	0.282**	**0.305****	0.264**	**0.326****	0.225**	0.175**	0.219**	**0.439****	**0.420****					
26	0.249**	0.119*	0.117*	0.144*	0.264**	0.215**	0.191**	0.156**	0.165**	0.130*	0.267**	0.231**	**0.301****	**0.327****	0.203**	**0.355****	**0.320****	**0.349****	0.239**	**0.362****	0.199**	0.213**	**0.474****	**0.490****	**0.397****					
27	0.220**	0.160**	0.216**	0.215**	**0.317****	0.223**	0.246**	0.210**	0.202**	0.171**	**0.334****	0.269**	0.281**	**0.325****	0.221**	**0.351****	**0.332****	**0.324****	**0.309****	**0.366****	0.236**	0.203**	**0.387****	**0.545****	**0.377****	**0.479****				
28	0.128*	0.072	0.076	0.072	0.052	0.207**	0.168**	0.105	0.143*	0.128*	0.177**	0.212**	0.269**	0.252**	0.122*	0.104	0.103	0.209**	0.257**	0.246**	**0.298****	0.222**	**0.338****	0.173**	0.228**	0.271**	0.157**			
29	0.246**	0.173**	0.217**	**0.309****	0.270**	0.208**	0.258**	0.203**	0.274**	0.222**	**0.301****	0.246**	0.240**	0.277**	0.254**	0.262**	0.325**	**0.300****	**0.323****	**0.350****	0.277**	0.180**	0.284**	0.472**	**0.311****	**0.393****	**0.536****	0.257**		
30	0.242**	0.170**	0.180**	0.241**	0.223**	0.166**	0.254**	0.185**	0.281**	0.206**	0.285**	0.159**	0.285**	0.293**	0.260**	0.242**	0.282**	0.227**	**0.295****	**0.359****	**0.300****	0.136*	0.238**	**0.530****	**0.312****	**0.357****	**0.492****	0.251**	**0.724****	1.000

**** Correlation is significant at the 0.01 level (2-tailed)** *** Correlation is significant at the 0.05 level (2-tailed)**