

A CROSS-CULTURAL INVESTIGATION OF DESIGN AND VISUAL PREFERENCE OF SIGNAGE INFORMATION FROM HONG KONG AND PAKISTAN

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ABSTRACT:

Signage design has been considered critically important for wayfinding being a functional medium of delivering environmental information. Complex institutional environments have several factors affecting the wayfinding, including but not limited to the design of information signage and its visual preference. Visual preferences of information design in wayfinding signage vary depending upon the cultural and individual differences. This study intended to explore the variance in design and visual preferences of wayfinding signage and its influencing elements. Responses through online questionnaire have been accumulated by the participants from Hong Kong and Pakistan based on their design and visual preference of campus wayfinding signage. Questions were asked related to the user preferences for signage colour if in line with the institutional visual identity, mono or multi-colour coding of information and its visual volume. In total, 170 university students and visitors have participated in the exploratory study from the respective countries. The results demonstrated that participants of Hong Kong preferred inline colours of signage along with mono or less colour coded and detailed information. While the other group preferred attractive colours with multi-colour coded and less detailed wayfinding information with pictograms. Individual differences concerning age, literacy level and gender were also computed, however, trivial differences have been recorded. This study suggested the need for detailed cross-cultural investigation concerning elements of signage design and visual preference to identify the drivers for culturally consistent university signage.

Keywords: Wayfinding design, Visual perception, Signage design, Cross-culture, University signage

1- INTRODUCTION. Wayfinding is considered a challenging task in environmental settings with high levels of spatial intricacy, particularly when combined with a person's unfamiliarity with the specific environment. In some cases, wayfinding difficulties can cost institutions huge sums of money (Zimring, 1990). During wayfinding, a navigator has to rely on information from their surroundings to acquire the environmental knowledge necessary to locate their destination. This environmental knowledge concerning potential routes and destination can be obtained from – amongst other resources – maps and information signage. Although signage is not the only wayfinding aid present in spatial settings, it has been proven of great importance in gathering environmental information and reducing wayfinding time and frustration (Carpman and Grant, 1993; Rodrigues et al., 2018). Multiple studies (Butler et al., 1993; Fewings, 2001) have suggested that signage carefully placed in the environment can reduce wayfinding difficulties. A study (Holscher et al., 2007) has found that in the co-presence of wayfinding signage, the usage of a map for acquiring environmental information reduced by nearly two-thirds. Multiple factors enhance the impacts of signage while delivering environmental knowledge, including the design of information, signage visibility, location, materials, lighting and placement. A study (Sadek, 2015) has suggested that the signage position along with its design can influence the navigator's wayfinding behaviour and performance. Moreover, if the placement of signage and design is distinctive to the background environment and attract the viewer's attention then it can deliver the requisite environmental information effectively (Tzeng and Huang, 2009). Environmental information can make the

spatial environment legible for finding the required destination. In addition to that, the signage has several other functions including but not limited to: provide instructions, demarcations, identifications and warnings etc. (Landry and Bourhis, 1997; Spolsky, 2008). The identified core purposes of signage have been developed through its graphic, textual and symbolic information design.

1.1-Signage categories. The information signage has several classifications based on its provided information category and purpose. An investigation (Tzeng and Huang, 2009) has suggested a classification of signage design based on the type and detail of information i.e. simplified and detailed information. According to this study, three classifications have been established based on the nature of information like direction, identification and orientation signage. On the other hand, a study (Boyd, 1993) has suggested the five fundamental categories of signage system mentioning information signage and regulation signage in addition to the previous classifications. The signage types serve different functions in a spatial set up to facilitate the wayfinding, either in telling the directions or in building up the survey & route knowledge. Each signage type has comprised of the information in the form of text, pictograms, colours and directional symbols. The directional signage has been comprised of the information regarding path or route directions having directional arrows or symbols while the identification signage has the information pointing certain landmarks, buildings and facilities to strengthen one's sense of orientation. Furthermore, a study (Wallace, 1997) has described that orientation signage has large scale information of spatial environment while highlighting the important knowledge points. Moreover, regulation signage has information regarding general regulations within a building or a cluster of structures while information signage has general information based on distinct spatial characteristics. The mentioned categories have several characteristics based on the nature of the information provided which may require a further thoughtful insight concerning cultural and individual-related (age, gender, education etc) aspects.

1.2- Signage characteristics. The information design on wayfinding signage demands special consideration regarding the use of language, the volume of information, placements, colours and the usage of symbols or pictograms. An investigation (Hughes et al., 2015) has suggested that the high information density in the signage may lead to inefficient wayfinding as they are the key factors of producing stress and confusion amongst the navigators. An investigation (Carr, 2006) has suggested the substantial need for careful consideration in the design and placement of signage within a spatial environment to avoid confusions for navigators. While designing the signage, placement and visual attraction of design elements (fonts, symbols, colours & information content) play an important role in delivering effective information. Multiple studies (Rousek and Hallbeck, 2011; Shim and Paik, 2003) have investigated the role of text and its influences on human wayfinding behaviour and suggested that the text, typeface, and its layout composition can alter the way navigators comprehend the information.

The navigator's ability to comprehend the signage information is dependent on the style and composition of fonts in conjunction with the information content. The study (Berger, 2010) along with the standardization authority (Ministry of Health-NSW, 2014) have suggested that the usability of signage information may increase if the design format and text layout is consistent through the wayfinding design. Another study (Leonard et al., 2014) has investigated the signage standardisation and found it instrumental in making the signage easier to locate and comprehend. The study also emphasizes on the simplification of the supplied information and graphics. In addition to the source of information, the design of wayfinding signage can also be perceived as an added value for institutional branding. A study (Bruce and Daly, 2010) has found that the signage design can reinforce the institutional value to the user by giving wayfinding information as well as strengthen the identity of the organisation. This design uniformity can also influential in building up environmental knowledge while requiring less

cognitive efforts. The process of comprehending the information is strongly influenced by the knowledge and previous experience of the signage design (Trisnawati and Sriwarno, 2018).

The designing of signage demands a strong and critical approach as it has a strong impact on wayfinding behaviour and performance. The efficient signage system in an architectural environment can increase the environmental legibility as well as make the spatial surroundings more efficient in wayfinding. There are several principles established in an investigation (Bao, 2004) concerning the purpose, aesthetics, visual strength, placements, colours, size and forms of information signage especially to be placed in the university libraries. Special consideration is given to the library information design due to its complex spatial layout. The physical layout of libraries usually consists of large hallways with book stacks, administration rooms and designated reading areas. Users usually find it difficult to locate their desired locations in the absence of effective wayfinding information. The requirement of signage design may vary because of environmental surroundings, as every spatial environment is different in the complexity of layouts as well as demands specialised tasks to do. Another study (Stoller, 2013) has investigated the problems in wayfinding system in the four different airports across the USA. The study identified the design of information as an integral part affecting wayfinding behaviour. The wayfinding at airport terminals is considered to be crucial due to the tight schedule of passengers' itineraries. The passengers are required to navigate effortlessly to locate their desired location at the terminal. Considering time as a focal point, the wayfinding information at airport terminals should be accessible and comprehensible for a majority of users. In this regard, multiple studies (Alant et al., 2010; Hideyuki et al., 1978) have identified the important visual elements of information design such as the colours in recognising wayfinding symbols and the preferred text styles to attract the navigator's attention. In totality, the signage design has several standardised components for designing the information content. These components include the style of text, language, symbols, colours, placements, layouts, materials, effects of lights. The individual's perception of information signage may be dependent on multiple factors based on their knowledge and past experiences about the signage (Trisnawati and Sriwarno, 2018).

Some constraints have been explored in the usage of signage design components and their information delivery techniques. A study (Scialfa et al., 2008) has investigated the role of text in the presence of symbolic information and identified that the text may deliver the information more completely or precisely than symbols, but is limited because it can only be understood by people who read that particular language. Other studies (Hashim et al., 2014; Lee et al., 2014; Sunyavivat and Boonyachut, 2013) have also suggested that the information communication can be increased by the symbolic information in comparison to the text as they are more prominent and attractive to the navigators. However, the studies (Boonyachut et al., 2012; Mollerup, 2009) have investigated the impacts of textual directions and found it more influential in impacting people's wayfinding behaviour. In addition to that, the studies (Collins and Lerner, 1982; Lehto, 1992; Paivio, 1986; Santa, 1977) have discussed the relationship and comparison of symbolic information with textual information and suggested that the text has the volume of information but symbols can be perceived better and quicker amongst the navigators of same cultural backgrounds. A study (Toms and Campbell, 1999) has also suggested that the cognitive processing of visual form happens faster than that of semantic content, and that form is prioritised over the content. Additionally, the pictograms can be stored for a longer period in human memory due to their quick meaningful understanding and appropriate level of complexity (Abdullah and Hübner, 2006). The level of complexity can decrease the legibility of the pictogram as the comprehension of the providing information becomes difficult for the human mind to store and process. Pictogram can control the amount of added information while designing to enhance its legibility and wider understanding (Mahmoud, 2015; Wolff and Wogalter, 1998). Hence, the use of textual information may have

detail amount of concerned knowledge but require the understanding of respective language while pictograms are easy to understand, long-lasting on memory but require a substantial cognitive effort in deciphering the information.

1.3- Footprints of culture and individual differences. Culture has a strong influence on the human thinking style and ascribed behaviours towards wayfinding tasks and performances. It can influence the cognitive style rather than the existence of specified processes to deal with daily life problems (Dasen, 2018). Due to the differences in cognitive style and comprehension abilities, signage information design has a varied understanding amongst users. The signage graphics and pictograms may be perceived differently across cultures due to their specified way of thinking and different level of associations (Mahmoud, 2015). A study (Foster and Afzalnia, 2005) has investigated the symbols' comprehension and reported insufficient research for cross-cultural differences. Due to the mentioned lack of research knowledge, it is important to test the signage efficiency and ability to transfer information across the range of cultures to make the design components universally acceptable. Correspondingly, the study (Hashim et al., 2014) has insisted on the cross-cultural evaluation of signage design within different environmental settings as well as with individual differences. The ability of information delivery of signage is quite dependent on the surrounding environmental settings, layout plans and lighting conditions.

Consequently, multiple studies (Lee et al., 2014; Salmi, 2007) have investigated the signage design understanding amongst the range of cultures within healthcare institutional settings. The reported data in those studies from three distinctive cultures have several interesting insights based on the complexity, association of signage-pictograms and symbolic information. According to this exploration, some pictograms are understood by the users while others are difficult to deliver the desired information. Healthcare settings require very careful consideration of the usage of wayfinding information. A loss of time due to wayfinding problems in a healthcare setting can at worst lead to loss of life, and even at best it leads to a significant drain of resources from primary healthcare activities (Zimring, 1990). The usage of universal symbols and multilingual textual information is preferred in the healthcare settings due to the critical importance of inside wayfinding. There is quite a short number of symbols and pictograms that have been developed while having the widest understanding across the globe (Tijus et al., 2007). Although the universal understanding is seemingly impossible due to many uncountable diversities, it can be anticipated by exploring the common platforms of experiences. However, the studies (Pati et al., 2015; Rousek and Hallbeck, 2011; Shim and Paik, 2003) have investigated the similar concept and came up with a solution of adding the descriptive text with pictograms to ease down the cognitive process of information gathering and understanding from signage. The symbols have been developed and tested on a larger population for comprehensibility and then standardised by the organisations (ISO 16069, 2004). This somehow suppressed the problem, however, the need for understanding the language in conjunction with the symbols is still there.

The wayfinding information gathering and understanding through signage depends on several other factors than cultural variations. The individual differences like age, gender, education level, literacy and physical disability can affect the signage interpretation along with the accessibility. There are changes in human cognitive abilities with age (Devlin, 2014) as well as with gender differences (De Goede and Postma, 2015; Hund, 2016). The signage interpretation can be different because of the evolution in choice and preference of colours, designs and complexities with ageing. Especially, if the surrounding environment is complex and the wayfinding information is difficult to understand i.e. institutional specific (hospitals, universities and other public sector institutions). The level of education can also be an influential factor as with the increased level of literacy there is an increase of cognitive abilities as well as symbolic association.

A study (Hashim et al., 2014) has also suggested performing the research on signage interpretation by the participants of different cultures, age and education background. There is a critical need for such research on signage design and its understanding across different cultures and individual differences to develop and improve the guidelines for culturally consistent signage graphics. As per the standards maintained by ISO (ISO 9186-2, 2008) and the United States of America (ANSI Z535-2011), the signage should be interpreted correctly by 67 % and 85% of the users respectively in order to claim it universally understandable. The institutions like universities situated in dense urban areas are offering fused facilities, shared nature of resources along with the complex spatial planning. A study (Abu-Ghazze, 1996) has investigated the legibility of a university campus for newcomers and suggested that the wayfinding can be a crucial task where environmental settings are homogenous. The homogeneity of the environment makes it complex for memorising and planning even for the experienced users. The complex environment impacts the user's wayfinding behaviour and also the need for easy acquiring of wayfinding information. The institutional oriented signage design like university campuses should be one of the primary focuses of cross-cultural research as the mentioned institution is neglected in the previous studies (Iftikhar, Shah, et al., 2020). Such cross-cultural studies will help in suggesting the cultural limitations for the designers and help them to develop the inclusive system of wayfinding design.

For obtaining the environmental information through signage, the users need to perceive the information correctly regardless of the individual and cultural differences. Certain variables consisting of colours, colour coding and volume of information are influential in signage design and preferences. To explore the impacts of the mentioned variables from the existing literature, the following research questions have been developed.

RQ1: Do users prefer signage colour if it is aligned with the institutional visual identity?

RQ2: Can mono or multi-chromatic coded signage information preferred differently by the wayfinders of different cultures (collectivists and individualists) in complex environments?

RQ3: What volume of signage information is preferred for easy understanding across two distinctive cultures with low environmental legibility?

The respective signage designs have been generated with varying levels of information content and colour types to explore the users' preferences while navigating in complex environments.

2- METHOD. The study was aimed to explore the cultural and individual influences on the user preference of wayfinding signage design in a spatially complex university campus. This investigation has been conducted through an internet-based questionnaire by the participants from Hong Kong and Pakistan. The cluster and convenience sampling have been used in obtaining the data from participants. Based on the number of students from both regions, the appropriate sample size has been identified (Conroy, 2015). Total of 170 students and general university campus visitors have participated in the study and expressed their preferences regarding the design of wayfinding signage. The visuals of signage design based on requisite research variables have been designed and used to investigate the user's preferences. The questions related to design preferences have been asked by providing four options of design visuals followed by a question related to the reason for preference. The collected data has been statistically analysed for the correlation between cultural and individual differences in wayfinding design preference. Before data collection, ethical approval from the concerned institutions has been obtained and the relevant protocol was followed as per the provided guidelines.

2.1- Questionnaire construction. This internet-based questionnaire has been constructed to gather the cross-cultural and individual-related information from the participants. The questionnaire was constructed by having two integral parts consisting of participants' demographic/personal information and the signage preferences. For the first segment (Table

1), the participants were asked about the demographics along with the personal information which was necessary to identify them as a respective group as practised in the previous studies (Chu and Martinson, 2003; Joy et al., 2016; Olmstead, 1999; Trisnawati and Sriwarno, 2018). The participants were asked about their place of birth, place of residence and native language to identify them as a distinctive cultural group. Participants were segregated in the cultural groups of Hong Kong China and Pakistan based on the above questions. The Hong Kong (China) group have the participants who have mentioned Mainland China or Hong Kong as their place of birth and residence along with Cantonese or Mandarin as their native languages. The participants who identified Pakistan as their place of birth and residence and Urdu as their language have been classified in the group of Pakistan. The participants were also asked about their gender, literacy level and age to investigate the individual differences in campus signage preferences.

[Table 1 near here]

[Figure 1 near here] [Caption: Signage design as a visual identity]

The further segment of the online questionnaire has three questions related to signage graphics exploring the user's preference for the signage design and information content. The questions have been designed based on signage as a visual identity, information colour coding and the aggregate of information. The first signage question as depicted in Figure 1 was designed to investigate the role of wayfinding design as a visual identity and users' preferences for environmental information while roaming inside the university campus. The question was designed to investigate the anticipated impacts of signage design on user's preference as depicted in the previous studies (Leonard et al., 2014; Rooke et al., 2009) where information design and its standardisation has been suggested for wayfinding efficiency inside a building. The four designs of signage in the first question (Figure 1) have been delineated containing a similar set of wayfinding information but with the difference of colours in the signage top plate. The first colour option was in line with the university colour theme while the other three were the signage colours used in the wide range of university campuses situated in Hong Kong and Pakistan. The participants were asked which signage colour would be more suitable to be placed in the university whereas the official colour was provided in the university logo.

[Figure 2 near here] [Caption: Colour coding in signage]

The second question (Figure 2) was designed to explore the effects and efficiency of colour coding in delivering the wayfinding information to the requisite users. The colour-coded information has a strong impact on the user's sense of perception, attention and identification of the relevant information. An investigation (Tzeng and Wang, 2011) has explored the mentioned influences on human wayfinding performance particularly in the university libraries where the environmental information was in huge volume. The results have demonstrated significant influences on the wayfinding performance, as the information was easy to read and identified by the navigators. On the contrary, the study (Delvin and Bernstein, 1997) has demonstrated no significant effect of colour coding in maps on wayfinding performances. In this question, four information graphics as shown in Figure 2 have been designed starting with greyscale or mono-colour coding to multi-colour coding for the wayfinding information. The respondents were asked about which signage would be preferred to be placed in the university whereas the four colour-coded options were provided based on mono to multi-colours.

[Figure 3 near here] [Caption: Signage information volume]

The third question (Figure 3) also contained four types of signage graphics having the difference in information volume by the usage of dual language along with the symbolic representation. Previous studies (Joy et al., 2016; Kuo, 2003; Scialfa et al., 2008) have suggested the reduction of words for precise and effective information. It was also suggested to increase the negative areas for breathing space in design influential in attracting the user's attention and increasing the comprehension. For the investigation of this user preference, four signage designs have been developed with the different combinations of language and pictograms consisting of dual language (English-Cantonese for HK, English-Urdu for Pak), single language, single language-pictogram and dual language-pictogram. In both regions, English is the official language while the Cantonese and Urdu are the local languages of respective groups. Cantonese scripts are written in left to right direction like English, whereas Urdu is written in the opposite direction. The participants were asked about their ease of understanding the signage information being placed in a university campus as the level of information details vary by the use of dual language and wayfinding pictograms. While considering the fact that the spatial layout of the university campus is complexly designed having a lot of environmental information required for efficient wayfinding.

2.2- Data collection process. For data collection, participants have been invited to perform an online questionnaire from Hong Kong and Pakistan. The invited respondents were generally university students and campus visitors who were contacted through the online service of google forms to gather the information. For this purpose, reputed university campuses have been selected in Hong Kong and Pakistan respectively because these institutions attract students and visitors from various cultural backgrounds. Total two hundred participants have taken part in the investigative study of signage design preferences. For this study, inclusion criteria have been developed based on the core cultural groups and the completion of responses. Total of 170 responses has been selected after satisfying the inclusion criteria for respective cultural groups belonging to either Hong Kong or Pakistan. The main respondents were the students of the respective university along with the general visitors of the campus. The questionnaire has been conducted in the English language, which is widely accepted and spoken in both of the places.

2.3- Data analysis process. To perform the data analysis, the gathered data has been arranged in respective independent cultural groups of Hong Kong and Pakistan. The participants having Mainland China as their place of birth have also been considered in the same cultural group of Hong Kong. For the exploration of individual difference, the participants have been independently categorised based on age, gender and the literacy level. The categorization has been detailed out in Table 2. After the required classification necessary for analysis, the data was imported into Microsoft Excel for descriptive analysis followed by statistical analysis using SPSS software.

The required information was gathered by the participants using the different visual options of signage graphics and open-ended explanation questions. As the participants have been independently grouped based on cultural and individual differences, Pearson's Chi-square test has been considered appropriate (McHugh, 2013). For the reasoning part, the data mining technique has been applied and categorised the findings into relevant classifications (Friedman, 1998) by the help of identifying the sequential pattern technique. The above-mentioned tests were used to explore the anticipated cultural differences for the design and visual preference of campus wayfinding.

3- RESULTS. The initial descriptive showed a number of adequate participants in each group related to cultural and individual differences to perform the statistical analysis. After applying the initial inclusion criteria, approximately 170 (84%) responses have been selected

to be included for the study. The details of the initial descriptive in Table 2 have provided a reasonable distribution of participants amongst both cultural groups as well.

3.1- Initial descriptive statistics. The summary of the general demographics showed a detailed distribution of participants belonging to the independent sample group. The response rate from the participants of Hong Kong was higher in comparison to the Pakistani participants by having 55% and 45% respectively. In addition to that, a similar kind of proportion has been turned out for the group based on gender i.e. females around 54% and males around 46%. For the further exploration of individual differences, the participants' ages have also been categorised in the group of four starting from 18 years to 37 years with five years of gap in each group. The collected data showed fewer members falling in the fourth group of 33-37 years; therefore, the group was merged with the third group of 28-32 years for maintaining a reasonable range in the individual group for statistical analysis. The major concentration (81%) of the participants was in the first two groups (18-22 years, 23-27 years) as the respondents were majorly university students. The level of literacy was another measurable parameter regarding the signage visual preference. The participants were asked about their current level of education, and from the collected data, two categories have been formed consisting of below undergraduate and postgraduate & above. The above-mentioned two categories have an equal number of participants (85) in each group. After the general categorization, the data was imported in SPSS for the further definition of research variables regarding the preference of signage design.

[Table 2 near here]

In the second part of the online questionnaire having questions related to the design of signage information, the responses were received based on the user's preferences. For signage as a visual identity, the highest preference has been received for design option 1 having 61% followed by option 2 which is 22% as depicted in Table 3. The second question was related to the preference in colour-coding of the wayfinding information and the users preferred design option 4 with 59% responses along with option 2 with 24% responses. In the question related to signage information volume, the responses were of distributed preferences i.e. 47%, 36.5% and 13.5% for option 4, 3 and 1 respectively. The detailed summary of the responses concerning design preferences by the participants has been mentioned in Table 3. Every question of design-related preferences had a follow-up question related to the explanation of the participant's selected choice. The explanatory questions were open-ended; therefore, the information was gathered and data mined by identifying the sequential patterns. Furthermore, the whole responses have been categorised based on the identified patterns as mentioned in Table 4.

[Table 3 near here]

[Table 4 near here]

3.2- Cross-cultural comparison. For the exploration of cross-cultural differences in signage preferences, the data has been organised based on participants' cultural background. In the questions related to signage design as a visual identity, a substantial number of respondents (69, 13) from Hong Kong have selected the first and second option respectively. The explanations for the particular selections have been provided with the relevance of the university's official colour and attractiveness. On the contrary, the participants from Pakistan have distributed preferences in signage selection. The first, second and third options have been

selected by 35, 24 and 14 number of Pakistani participants as demonstrated in Table 5 and Table 6. The participants from Pakistan have selected the requisite options due to the preference given to colour attractiveness over colour matching quality with the university's official theme. For the statistical analysis of the correlation between the responses of both cultural groups, the chi-square test has been applied. The significant relation has been recorded between the two cultural groups for questions related to signage design as a visual identity, $\chi^2(3, 170) = 24.016$, $p = 0.000$. Whereas, the explanation for the respective choice have also a significant relation, $\chi^2(2, 170) = 6.026$, $p = 0.049$.

[Table 5 near here]

[Table 6 near here]

While answering the second question based on the colour-coded information on the signage, the respondents also have a difference of opinion due to cultural influences. A substantial number of respondents from both groups have chosen the fourth design option with multicolour information coding followed by option 3 for Pakistani participants and option 2 for Hong Kong participants. After multi-colour-coded signage, Pakistani participants preferred the presence of colour for information coding by choosing the monochrome design option with differentiating shades and tints of the same colour. On the other hand, the respondents from Hong Kong have preferred the greyscale design option with the presence of a single colour with monotone. A significant relationship has been found between both cultural groups for the choice of colour-coded signage design options, $\chi^2(3, 170) = 16.844$, $p = 0.001$. Due to the difference present in the design choices, a significant difference has also been recorded in the provided explanation for the respective choices, $\chi^2(4, 170) = 29.274$, $p = 0.000$. The high value of phi (0.415) in Table 7 has also demonstrated the significance of relationship amongst both cultural groups. The third set of design options was designed based on the density and modes of information necessary for wayfinding tasks. In this particular set, the first two design options were based on the language provided information.

[Table 7 near here]

[Figure 4 near here] [Caption: Simple statistics of cross-cultural comparison]

In addition to that, the other two design options were designed by having the consideration of language and symbolic information together. A simple statistical comparison in Figure 4 has been produced to graphically depict the cross-cultural differences in the preference of signage design. The participants from Hong Kong have preferred the fourth option followed by the first and third option. The participants from Hong Kong were more concerned about the information provided by the dual language. Contrarily, the participants from Pakistan have considered pictograms as their reason of choice followed by the presence of dual language. A number of respondents from Pakistan have also described the ample information volume as a reason for selecting design option 3. Pearson's chi-square test has identified a significant relationship between the two above-mentioned cultural groups for the selection of signage design, $\chi^2(3, 170) = 44.751$, $p = 0.000$. The high value of phi (0.513) has also demonstrated the strength of correlation between the respondents from Hong Kong and Pakistan. In addition to that, a strong relationship between both participatory groups has also been found while comparing the explanation of these responses, $\chi^2(3, 170) = 30.586$, $p = 0.000$. A majority number of Hong Kong participants have selected the Q3 option 4 due to its detailed information layout. The group of Hong Kong have mentioned "use of dual language" as main the reason for their

selection while Pakistani participants selected the design options due to the presence of pictograms.

3.3- Individual influences. In the online questionnaire, the respondents were asked about some individual related question including gender, age and education level for the exploration of individual differences in the preference of wayfinding signage design. To identify the gender-related differences, two groups based on participants' gender have been formed. For analysing the correlation between males and females, the chi-square test has been applied (Table 8). In this study, no significant relationship between males and females has been recorded for analysing the preference of campus signage design.

[Table 8 near here]

Furthermore, this study was required to explore the age-related differences in the signage preference as identified in the previous literature. Initially, the participants have been arranged in four age categories starting from 18 years till 37 years with the difference of 5 years in between. The last two age groups have a very limited number of students; therefore, these two categories were merged to maintain an ample number of participants in each group. The three age categories have been identified in Table 2 for the statistical analysis to explore the correlation between them. The chi-square test has identified no significant relationship between the age categories (Table 9). The respondents have perceived the wayfinding signage irrespective of the age categories. This study has been conducted by the participants with fewer age differences as the participants were either university students or university campus visitors. The age gap was smaller in categories, due to which no significant findings have been recorded. It may require larger differences of age in groups to depict the difference in visual preference.

[Table 9 near here]

Correspondingly, the next identified category was established based on the level of the participant's education. The respondents have been segregated due to their reported level of education. Two categories have been established, in the first category the participants were having the education level equals to undergraduate or below and the second was having the participants of postgraduate and above education level. Chi-square test has been applied for further exploration of significant correlation between both categories. As a whole, there were no statistically significant relationships between both education level categories have been recorded (Table 10) except in the question related to the explanation of the information volume, $\chi^2(3, 170) = 10.208, p = 0.017$. The participants with the education level of undergraduate and below preferred the signage design option 3 and 4 for question 3 due to the presence of simplicity, dual language and pictograms. However, participants with a higher education level (postgraduate & above) choose the options due to the presence of dual language. We can infer from this finding that people with higher education level prefer written information more in comparison to the pictograms and density of information in the design of wayfinding signage.

[Table 10 near here]

Similarly, in the comparison for question 2 where different levels of information colour coding were provided, the participants with higher education prefer less presence of colour-coded information while the other group of the participants prefers colour coded designs as they are more attracted to the signage's colourful designs. Although the suggested relationship is not statistically significant, this insight can be seen in the slightly higher phi value (0.198), $\chi^2(3, 170) = 6.646, p = 0.084$. The respondents have also described the above insights in their

explanation responses for the respective selection. The group with lower education level has described the factor of colour coding as a major driver for their selection while the other group of the participants has mentioned other reasons as well like the presence of less colour and ample amount of information.

3.4- Correlation analysis. In addition to the relationship of cultural and individual differences, the acquired data was further explored for the correlation between the questions by applying the spearman's correlation analysis. The respective analysis had produced some interesting insights based on the individual's preferences other than the previously mentioned relationships in Table 2. A statistically significant correlation has been observed and demonstrated in Table 11 between the Q1 and Q1exp depicting the choice of signage design and its respective explanations. The participants have given more preference to design option 1 due to its colour matching with the university theme than the attractiveness of colour. On the other hand, those participants who have chosen the design option 2 in question 1 have given the explanation in favour of using the attractive colour in the design of campus wayfinding signage. Similarly, the respondents who have chosen the signage design option in line with the university theme preferred design option four in question three related to a greater volume of information. Through this study, we can infer that if the signage has been designed as an institutional visual identity then people prefer the large volume of wayfinding information along with the symbols.

[Table 11 near here]

Subsequently, a statistically significant correlation has been found between Q2 and Q2exp. The participants who preferred the design option 4 in Q2 have presented colour coding as the main reason for the choice. On the other hand, the remaining design options in Q2 have been selected profoundly due to the usage of fewer colours. We can deduce that participants perceived colour coding information better but with less usage of colours in the information coding especially when the signage design needs to be installed in the spatially complex university settings.

4- DISCUSSION. Being exploratory, this study demonstrated a substantial amount of differences related to the cultural influences and individual diversities in the preference of university signage design. Multiple studies (Ahmed, 2015; Iftikhar, Asghar, et al., 2020; Troncoso, 2014) have explored the cultural influences on human wayfinding behaviour to facilitate institutional settings. For this study, the aim was to investigate the cultural influences on user preferences by comparing the participants from Hong Kong and Pakistan. Statistically significant differences have been recorded for the preference of the signage design as a visual identity to the institution. Studies (Hohmann, 2001; Leonard et al., 2014) have suggested the standardisation in the signage design and colours with institutions for enhanced visual understanding.

The suggested recommendation was true for the participants from Hong Kong because they have selected the colours in accordance with the university theme and logo. However, the participants from Pakistan also recommended for the usage of attractive colours in signage design. As per their suggestion, the signage graphics should not necessarily be in line with the overall institutional theme. This study also explored that the colour coding of the information in university wayfinding signage should be kept within an adequate range of colours. Respondents from both cultural groups suggested the usage of information colour coding, however, the respondents prefer the usage of less number of colours. Moreover, the participants from Hong Kong also preferred signage design with grey and single colour coding while the other cultural group prefers the usage of colour's tints and shades rather than the usage of

multiple colours. The mentioned cultural differences have been recorded for the user preferences of signage design and may not be a reliable indicator for the cultural differences in wayfinding behaviour.

Furthermore, critical differences have also been recorded for the volume and type of signage information. Studies (Mahmoud, 2015; Wilkinson et al., 1997) have suggested that the textual information can be easier to obtain than pictograms as the text requires a less cognitive effort to decipher the information. Our findings are consistent for the participants from Hong Kong with the above-mentioned studies; however, the Pakistani participants have perceived the information better in the form of pictograms and symbols. The group of Hong Kong prefers the design of signage with a detailed amount of information while the other cultural group only goes for the necessary and basic information.

The results have also depicted the less signage dependency by the Pakistani participants than the participants from Hong Kong. The cause of this could be the relying of the Pakistani participants on obtaining verbal wayfinding information from the passer-by. A similar study (Ahmed, 2015) has been conducted in the culturally similar and neighbouring country (India) of Pakistan for users' preferred style of obtaining wayfinding information. The users relied more on obtaining verbal information rather than reading wayfinding signage. The significant difference in all of the questions depicted evidence of cultural diversity in the preference of signage design and was consistent with the previous study (Foster and Afzalnia, 2005).

This study further explored the gender differences in the preference of wayfinding signage design. According to the results, no significant gender differences have been recorded for question 1, 2 and 3. The findings are considered to be consistent with the previous study (Lee et al., 2014) where no gender difference has been demonstrated in the visual preference of signage information. Although previous studies (De Goede and Postma, 2015; Hund, 2016) have identified that the cognitive abilities differ with the change of gender, however, these cognitive differences were not significant enough in the comprehension of wayfinding signage information and design. For further exploration, the signage design preferences have been explored across the different categories of ages. The results have enunciated no statistically significant relationship between the different categories of ages for signage information design. Multiple studies (Head and Isom, 2010; Taillade et al., 2013) have investigated the age-related differences affecting the wayfinding performance and found it a significant driver for influencing user preferences. On the contrary, the findings in our study have depicted no relationship between the above-mentioned age groups.

In addition to that, this study explored the relationship of education level influencing the preferences in wayfinding signage. In the previous literature, study (Joy et al., 2016) has identified that the level of education can be influential in affecting the user's sense of perception. On the contrary, the study (Dowse and Ehlers, 2003) have investigated the said relationship and the findings were different as the relationship was not statistically significant. In our exploration related to the signage preference, a significant relationship has been recorded in question Q3exp related to the volume and type of information in wayfinding signage design. The participants with lower literacy level have preferred multiple types of information in the forms of textual and symbolic references along with the preference given to minimal and effective environmental knowledge. Alternatively, the participants with higher literacy level preferred detailed textual information and the usage of dual language. This can be further interpreted, as the participants with higher education level are comfortable with the detailed textual knowledge rather than the usage of symbolic and pictographic information.

Furthermore, spearman's correlation test has also been applied to investigate the detailed interrelationships of signage questions. The correlation analysis has suggested that the institutional visual identity in signage design have an influence on the user's preferences. If the standardization and visual identities have been incorporated then the greater volume of

information can be understood better amongst the users. Once a necessary level of familiarity in design and colours has been achieved, it becomes less distractive for way finders in receiving the environmental information. The obtained results for this study have been consistent with the principle of signage design (Bao, 2004) in the complex university settings. Colour coding of information on the wayfinding signage has also been found instrumental in delivering the wayfinding information, however, our investigation suggests using monochromatic colours for coding, as it is preferred especially when the environmental legibility is poor and it is loaded with distractive information.

5- CONCLUSIONS. Searching for a destination in a complexly planned and multi-storey institutional environment is a strenuous task and requires a lot of cognitive effort, environmental aids and route knowledge. The wayfinding aids can be of different types ranging from signage to landmarks. The effectiveness and dependence on signage for wayfinding information are quite evident in the previous literature while identifying the need for easy comprehension and standardised design of information content. The complexly planned university campuses need a good amount of research in this regard, as these campuses attract quite a number of visitors having various individual and cultural diversities. This investigation aimed to explore the factors being potential barriers for easy and standardised wayfinding design. This investigation has found cultural difference as a major driver in the disparity of obtained signage information. The participants from Hong Kong have shown a preference for the design of signage in line with the institutional official colours and themes. In addition to that, the preference has been given to textual information as it has been investigated in the previous studies to be less demanding of one's cognitive efforts. On the contrary, participants from Pakistan have been attracted towards the attractiveness of signage design, colours and the symbolic information. The reason for this preference potentially lies in the variation of wayfinding culture for the Pakistani participants. Due to the less availability of functional signage design, the users can be more attracted towards the other wayfinding information sources like verbal information, landmarks recognition etc. Due to this fact, they are not solely dependent on the signage information in obtaining environmental knowledge. It has been observed that symbols can play an important role in increasing the legibility and dependence on signage for both cultural groups. This inference can be true for the participants with varied level of education as symbolic or pictographic information can attract the users irrespective of education level. Moreover, it is also suggested to conduct future research on the efficacy of existing symbols in developing environmental knowledge for wayfinding. Along with providing the recommendations for improving the symbol design framework for complex environmental settings. The developed symbols can furtherly be tested in different environmental settings with varied level of spatial intricacy using computer simulations for mitigating the impact of environmental complexity.

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Table 1 Participant information in questionnaire construction

Information category	Questions
Demographic information	
	Place of birth
	Place of residence
	Native language
Personal information	
	Gender
	Age
	Literacy level

Table 2 Summary of general demographics

	Frequency	Percentage
<i>Cultural group</i>		
<i>Hong Kong (China)</i>	93	55 %
<i>Pakistan</i>	77	45 %
<i>Gender</i>		
<i>Male</i>	78	46 %
<i>Female</i>	92	54 %
<i>Age Group</i>		
<i>18-22</i>	69	40 %
<i>23-27</i>	70	41 %
<i>28-37</i>	31	19 %
<i>Literacy Level</i>		
<i>Undergraduate</i>	85	50 %
<i>Postgraduate & above</i>	85	50 %
<i>Total</i>		
	170	100 %

Table 3 Summary of questions responses

	Option 1	Option 2	Option 3	Option 4
Question 1 (Signage design as a visual identity)				
Frequency	104	37	16	13
Percentage	61%	22%	9.5%	7.5%
Question 2 (Colour coding in signage design)				
Frequency	6	41	23	100
Percentage	3.5%	24%	13.5%	59%
Question 3 (Signage information volume)				
Frequency	23	5	62	80
Percentage	13.5%	3%	36.5%	47%

Table 4 Summary of questions explanation responses

Question 1 explanation (Q1exp) (Signage design as a visual identity)					
	Attractive colour	Colour Matches Logo	Quick understanding		
Frequency	84	80	6		
Percentage	50%	47%	3%		
Question 2 explanation (Q2exp) (Colour coding in signage design)					
	Ample information	Attractive colour	Quick understanding	Less colours	Colour coding
Frequency	29	3	9	32	97
Percentage	17%	2%	5%	19%	57%
Question 3 explanation (Q3exp) (Signage information volume)					
	Ample information	Dual language	Quick Understanding	Pictograms	
Frequency	28	82	22	38	
Percentage	17%	48%	13%	22%	

Table 5 Summary of cultural differences in design selection

	Option 1	Option 2	Option 3	Option 4
Q1 (Signage design as a visual identity)				
Hong Kong	69	13	2	9
Pakistan	35	24	14	4
Q2 (Colour coding in signage design)				
Hong Kong	4	33	8	48
Pakistan	2	8	15	52
Q3 (Signage information volume)				
Hong Kong	20	2	14	57
Pakistan	3	3	48	23

Table 6 Summary of cultural differences in questions' explanation

Question 1 explanation (Q1exp) (Signage design as a visual identity)					
	Colour matches logo	Attractive colour	Quick understanding		
Hong Kong	51	38	4		
Pakistan	29	46	2		
Question 2 explanation (Q2exp) (Colour coding in signage design)					
	Ample info.	Attractive colour	Quick understanding	Colour coding	Less colour
Hong Kong	28	3	3	46	13
Pakistan	1	0	6	51	19
Question 3 explanation (Q3exp) (Signage information volume)					
	Ample info.	Dual language	Quick understanding	Pictograms	
Hong Kong	9	62	11	11	
Pakistan	19	20	11	27	

Table 7 Summary of cultural differences in questions' explanation

	Q1	Q1exp	Q2	Q2exp	Q3	Q3exp
χ^2	24.016	6.026	16.844	29.274	44.751	30.586
p	0.000*	0.049*	0.001*	0.000*	0.000*	0.000*
Φ	0.376	0.188	0.315	0.415	0.513	0.424

*p < 0.05 for Pearson chi square test

Table 8 Statistical analysis of gender differences

	Q1	Q1exp	Q2	Q2exp	Q3	Q3exp
χ^2	3.169	0.897	5.904	4.922	1.563	2.032
p	0.366	0.639	0.116	0.295	0.668	0.566
Φ	0.137	0.073	0.186	0.170	0.096	0.109

Table 9 Statistical analysis of age differences

	Q1	Q1exp	Q2	Q2exp	Q3	Q3exp
χ^2	5.707	2.793	7.356	7.515	4.630	6.395
p	0.457	0.593	0.289	0.482	0.592	0.380
Φ	0.183	0.128	0.208	0.210	0.165	0.194

Table 10 Statistical analysis of literacy level

	Q1	Q1 exp	Q2	Q2 exp	Q3	Q3 exp
χ^2	4.233	0.915	6.646	6.454	5.855	10.208
p	0.237	0.633	0.084	0.168	0.119	0.017*
Φ	0.158	0.073	0.198	0.195	0.186	0.245

* p < 0.05 for Pearson chi square test

Table 11 Spearman's correlations

	Q1	Q1exp	Q2	Q2exp	Q3	Q3exp
Q1	1.000					
Q1exp	0.376**					
Q2	0.131	0.031				
Q2exp	0.016	0.008	0.209**			
Q3	-0.193*	-0.051	0.117	-0.004		
Q3exp	0.061	-0.081	-0.098	0.011	-0.129	1.000

** . correlation is significant at the 0.01 level (2-tailed).

*. correlation is significant at the 0.05 level (2-tailed).

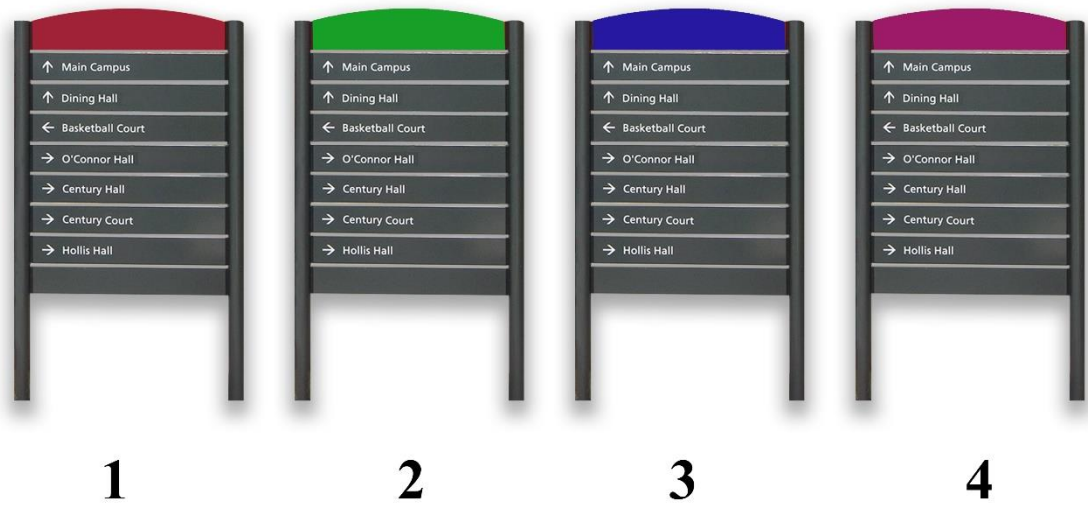


Figure 1.

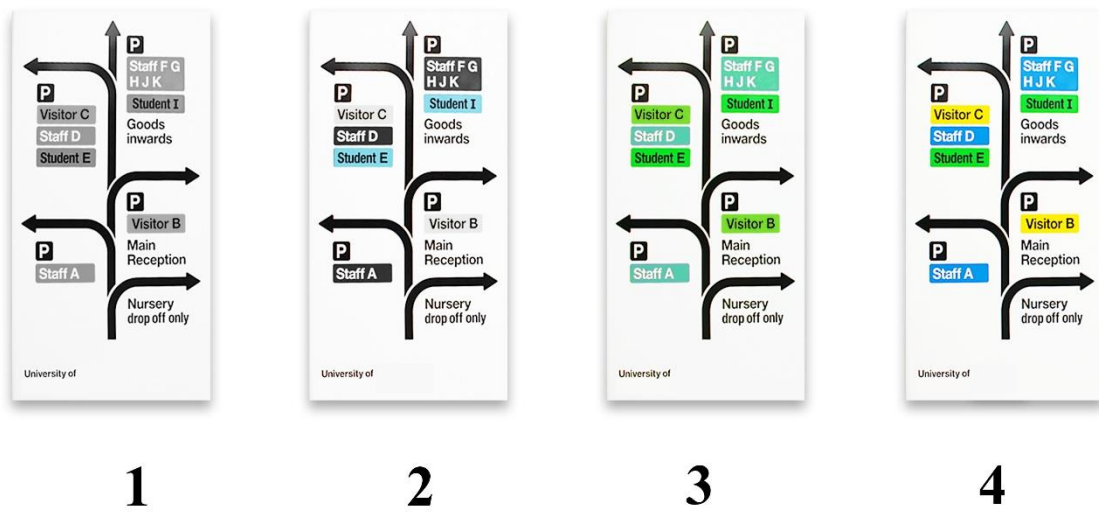


Figure 2.

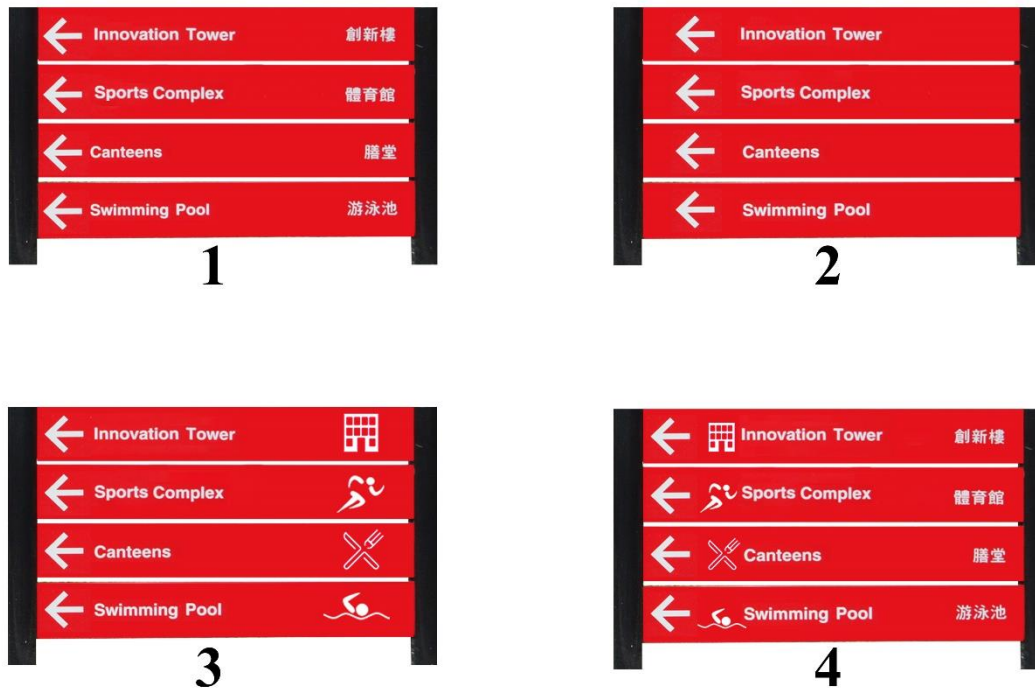


Figure 3.

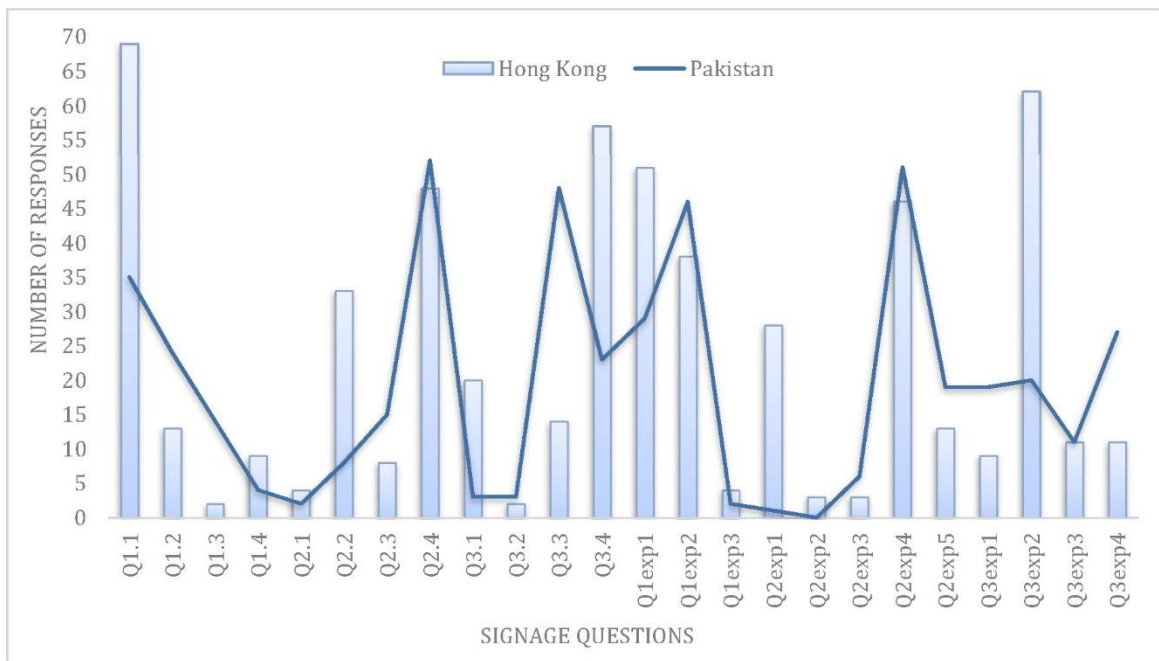


Figure 4.