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Comprehensibility of universal healthcare symbols for wayfinding in healthcare facilities

Seunghae Lee^{a*}, Sibel Seda Dazkir^b, Hae Sun Paik^c, Aykut Coskun^d

^aOregon State University, 327 Milam OSU Corvallis, OR 97330, USA

^b Georgia Southern University, School of Human Ecology, P.O. Box 8057, 1110 IT Drive, Statesboro, GA 30458

^cLand & Housing Institute, Korea Land & Housing Corporation, 462-2 Jeonmin-Dong, Yuseong-Gu, 305-731, Daejeon City, Republic of Korea

^dDepartment of Industrial Design, Middle East Technical University, Dumlupinar Bulv. Universiteler Mah. no: 1, 06800, Cankaya, Ankara, Turkey

Abstract

Healthcare facilities are often complex and overwhelming for visitors, and wayfinding in healthcare facilities can be challenging. As there is an increasing number of global citizens who travel to seek medical care in another country, it is critical to make wayfinding easy for visitors who are not familiar with the language in foreign country. Among many wayfinding aids, symbols are helpful for those visitors who have limited ability to understand written language. This study tested universal healthcare symbols in the United States, South Korea, and Turkey to compare the comprehension of symbols cross-country and identify predictors of the correct comprehension. To explore statistically significant relationships between symbol comprehension and countries, Pearson's Chi-square tests, logistic regression, and ANOVA were conducted. The test results showed that ten symbols among 14 tested have significant relationship with countries. Results of this study demonstrate that symbol comprehension can be varied significantly in different countries.

Keywords: symbol comprehension, universal healthcare symbol, wayfinding

* Corresponding author. Tel.: + 1 541 737 5952

E-mail address: Seunghae.Lee@oregonstate.edu

1. Introduction

A graphic symbol is defined by the International Organization for Standards (ISO-2227:2007) as a visually perceptible figure with a particular meaning used to transmit information independently of language (ISO, 2007). With this research, we tested the comprehension of some existing healthcare graphical symbols in three different countries: the United States, South Korea, and Turkey. Testing the comprehension of the healthcare signs that are used in settings such as hospitals to aid wayfinding for patients and families is critical to signage development that is comprehensible to international users. Furthermore, testing those signs internationally is necessary for developing standardized, universal signs.

Developing universal signs will allow people from different cultural and linguistic backgrounds to easily find their way in the hospitals and improve their experience in those settings. As the recent development and advancements in technology, communication, and transportation have expedited globalization, global integration has brought the world closer. The medical industry is not an exception to this trend. Patients from less developed countries have traveled to developed countries to receive better quality medical care as long as they can afford. The medical industry has witnessed patients who travel to the opposite direction. In other words, less wealthy patients from developed countries traveling to seek affordable medical care (Herrick, 2007). The globalization in healthcare industry may cause confusion and miscommunication as patients and their families may experience difficulties from cultural differences. In the era of increased globalization, developing universal signs will make it easier for people traveling internationally to reach quality care in hospital settings. In addition to international patients, members of minority populations who do not speak the major or the official language of that country and illiterate people would have difficulty finding their way in complex public environments such as hospitals.

Signs are very helpful for wayfinding, and effective wayfinding systems are critical in unfamiliar environments. It is indicated in the existing body of literature that public information signs in healthcare facilities need standardization (Gakopoulos, 2009; Hablamos Juntos, 2003; Rousek & Hallbeck, 2011). Thus, there is a need for international testing of those signs. This study focuses on healthcare symbol designs that may help patients who have different cultural and language backgrounds. The results from this study will benefit healthcare facility planners and managers to provide a better facility user experience through easy navigation for global citizens.

1.1. Signs and symbols

Many people visit healthcare settings in their times of stress and uncertainty while searching for healing. Lahood and Brink (2010) explained that “lighting, color, finish materials, furniture, and wayfinding are key design elements that define how comfort and

aesthetics can play various roles in the overall hospital aesthetic” (p. 23). Wayfinding can be defined as spatial problem solving (Arthur & Passini, 1992). It requires intellectual abilities including decision making, decision executing, and information processing. Among many wayfinding aids, signage is considered to be a critical component to help in wayfinding. Sounds (words) and images (symbols) are two basic ways to communicate. While people can communicate complex ideas effectively with words, signs are used across language barriers (Wyman & Berger, 2005). Signs carry words, symbols, or both. Signs direct people to destinations to which they desire to go. Settings such as hospitals are visited by people of diverse backgrounds. Therefore, it is crucial that the signage is designed to be comprehended universally (Salmi, 2007).

However, because signs are not interactive communication tools, people cannot ask questions when they do not understand them clearly. Thus, it is important that the messages on signs are easily understood without any further explanation and clarification (Carpman & Grant, 1993). People can navigate through hospital space easily when signs and pictograms are legible and can be clearly, quickly, and easily understandable (Gakopoulos, 2009).

Kendler (2002) highlighted the role of abstraction in signage design, as it simplifies the message and speeds up the cognitive process of comprehending the meaning by communicating the most important aspects of the referent. Simple, abstract line drawings are less distracting than a realistic representation of the referent. However, as Olmstead (1999) indicated, understanding the meaning of such abstract symbols depends on the viewer’s familiarity with culturally learned symbols. Cultural differences between the sender and receiver of signs can cause misinterpretation (Olmstead, 1999).

Cogwill and Bolek (2003) suggested that a graphic symbol should utilize the essential facts about the referent, that the design of the sign should be uniform throughout the graphic and graphic system, that the symbols should be visually simple, that silhouette or side views should be preferred since they are easier to understand compared to frontal views, and that a symbol should be designed to be distinct from other signs to prevent confusion.

Foster and Alfanzia (2005) also highlighted a lack of studies on signage comprehension that report international data. In their study, they found agreement on a single variant across three different countries, supporting the fact that international general principles can be applied to symbol standardization. However, they also found lower levels of comprehensibility in Iran compared to Korea and the U.K., signifying the importance of gathering cross-cultural data. Olmstead (1994) collected data in the U.S., Japan, and China to test 41 symbols for seven health-care referents. She found that five symbols were estimated highly both in the U.S. and China, suggesting that universal symbols for healthcare facilities have potential to be understood in a cross-cultural fashion.

1.2. International symbols for healthcare facilities

With the influence of increased interests in globalization, the use of symbols to communicate with people of different cultural and linguistic backgrounds has become more important in recent decades. Using pictograms would be helpful in countries with high illiteracy rates or with immigrant or minority populations who cannot speak the major language of that country. In addition to communicating the referent to a diverse population of visitors, healthcare settings facilitate graphic symbols to avoid wayfinding problems that are due to the technical terms used on signs (Olmstead, 1997). Too often, medical and technical terms are not understood by patients and visitors (Carpman & Grant, 1993).

Foster and Alfanzia (2005) noted that even though symbols are useful for communicating with people with different languages, the existence of many different symbols for any specific referent can be confusing. Public information signs for healthcare facilities have been used sporadically, and there has been a lack of research on their standardization (Olmstead, 1999).

Pooaviah (reported in Gakopoulos, 2009) conducted a case study on signage systems in five hospital settings in Bombay, India. India has 1600 dialects and 14 major languages, and the education level of the population varies (Gakopoulos, 2009). The numeric signage systems used in the hospitals at the time of the study caused difficulty in wayfinding, and people ended up waiting in the wrong line for a long period of time. Such confusions can be prevented by replacing the numerical signage system with pictogram-based signage.

Healthcare signs should be intuitive, but their meanings still need to be explained to the public via distributing booklets to schools, organizations, and communities (Gakopoulos, 2009). Cowgill and Bolek (2003) also claimed that a symbol's meaning can be taught or learned. Standards Australia tested the effectiveness of nine healthcare symbols, and results showed that respondents' comprehension increased by twelve percent for the second test (Cowgill & Bolek, 2003).

However, Brugger (1999) claimed that symbols can be misinterpreted across cultures. Foster and Alfanzia (2005) explained that the differences found in cross-cultural data would depend on the "cultural specificity of the symbol or referent." A form that has a specific meaning or association with a specific object or person according to a cultural group may not denote or connote the same meaning in another cultural group. According to Foster and Alfanzia (2005), it is difficult to conclude whether or not a symbol interpretation can be culturally limited because it depends on the symbol.

This study focused on some existing healthcare symbols and tested its comprehensibility in three different countries in order to find out if people who live in different countries understand healthcare symbols with the same level of comprehensibility.

2. Method

2.1. Participants

This study employed the stratified sampling technique to select survey participants. The population was first segmented into mutually exclusive sub-groups by age and gender. In the sample, there were three age groups: 18-30, 31-50, and over 50 years of age. In addition, there were two gender groups: male and female. Participants were recruited in three countries among natives of each country: U. S., South Korea, and Turkey. These three countries are considered to represent three distinct cultures including Western, Eastern, and Middle-Eastern. Each age group from each of the three countries included 20 respondents with 10 male and 10 female participants. Convenient sample of total 180 consumers participated in the study.

2.2. Procedure

The oral consent of the participants was granted prior to their participation in the study, and the purpose of the study and experimental procedures were explained to each of them in the aftermath. Each respondent also completed a self-report sheet that was adapted from the ISO's comprehensibility test. The self-report sheet was used for collecting demographic data about the respondents' age, gender, education level, cultural background, and whether or not they had vision problems that would influence their responses to the pictograms. No participant reported that they had vision difficulties that would impair their participation in the study.

The data collection was conducted using a hard copy questionnaire that included three sections: 1) the comprehension test, 2) the matching test, and 3) the judgment test. For each section, the respondents were told not to go back to their previous responses.

2.3. Measures and instruments

2.3.1. The Comprehension Test

The first section tested the comprehension of fourteen selected healthcare symbols (see Fig. 1) using the ISO comprehension test method. Those healthcare symbols were selected from a universal healthcare symbol set developed by Hablamos Juntos (<http://www.hablamosjuntos.org/signage/PDF/Best%20Practices-FINALDec05.pdf>), which is a project funded by the Robert Wood Johnson Foundation (<http://www.hablamosjuntos.org/default.about.asp>). The universal healthcare symbols were developed to help non-English speaking patients to navigate healthcare facilities in the U.S. Those 14 healthcare symbols showed basic information about some major departments in a healthcare setting including billing, cardiology, emergency, family practice, immunization,

intensive care unit (ICU), lab, medical files, ob clinic, pediatric, pharmacy, radiology, surgery, and waiting area.



Fig. 1. Healthcare symbols used in the comprehension and the matching tests.

An adjusted version of the ISO's comprehension test was utilized to analyze the comprehensibility of the signs. The comprehension test examined whether or not the respondents comprehended what each of the fourteen symbols referred to. Each symbol was displayed on a single sheet. Each of the pictograms was placed in a 2" x 2" (50.8 mm x 50.8 mm) square. The symbol was accompanied by a short description explaining that the symbol is used in healthcare settings. The respondents were asked about what they thought each symbol meant. Although the ISO's comprehension test asks what action respondents think they should take after seeing a particular symbol, this questionnaire did not ask which action should be taken because it was irrelevant to the context of the symbol. Before starting the comprehension test, the respondents were shown an example test sheet with an example pictogram and its correct answer.

2.3.2. *The Matching Test*

In the second section of the questionnaire, we showed the same fourteen pictograms that were used in the first section. All of the fourteen pictograms were shown together on a single sheet and each of them had a size of 28 mm x 28 mm. The test provided a list of healthcare department names, including sixteen hospital services (pharmacy, emergency, intensive care unit, waiting area, immunization, billing, surgery, ob clinic, lab, pediatric, radiology, medical files, family practice, cardiology, orthopedics, internal medicine, and dermatology).

2.3.3. *The Judgment Test*

This study tested emergency, cardiology, and pharmacy symbols using the judgment test developed by the ISO (International Standards Organization, 9186:2001). The authors collected symbol examples that were being used in each country's healthcare facilities. However, due to the limited uses of healthcare symbols, there were variants only from the U.S. and Korea for cardiology and pharmacy symbols. There were three variants for emergency symbols from the U.S., Korea and Turkey. The variants were printed for one

referent on one single white sheet. The respondents were informed in words what each symbol was supposed to mean (i.e. emergency or cardiology) and that the symbol was intended to communicate its meaning to the general population in a healthcare setting. Respondents judged how much each symbol was understandable by writing the percentage of the general population that the respondent expected would understand the meaning. Respondents were informed that the percentages they would write on all lines did not have to add up to 100.



Fig. 2. Healthcare symbols used in the judgment test.

2.4. Research Analysis

In order to examine how country, age, and gender are related to the comprehension of universal symbols, various statistical analyses were employed to analyze the data. All calculations were made using SPSS 20. For the comprehension test, Pearson's chi-square tests were conducted to examine universal healthcare symbol comprehension for cross-country, cross-age, and cross-gender comparisons. In addition, logistic regression was conducted to predict the healthcare symbol comprehension outcomes with predictor variables of country and age. For the matching test, cross-country tabulations of successes in universal healthcare symbol matching in percentages were developed to explore differences in matching cross-country. To compare cross-country matching success statistically, Pearson's chi-square tests were conducted for the same data. For the judgment tests, ANOVA was conducted for each symbol variant to compare cross-country.

3. Results

3.1. The Comprehension Test

ISO 3864 (1984) determined 67% as the criteria for comprehension of a graphical symbol. Many authors (e.g. Cowgill & Bolek, 2003; Rousek & Hallbeck, 2011; Wolff & Wogalter, 1998) used 67% criteria in their studies. Cross tabulation of the comprehension percentage in different countries was developed and shown in Table 1. Symbols that yielded 67% or more of the correct answers in all three countries were billing, emergency, laboratory,

ob clinic, radiology, and surgery. The symbols that received less than 67% correct response rate in each country were as following: cardiology, family practice, immunizations, medical records, ICU, pediatrics, pharmacy, and waiting area in Korea; pediatrics, pharmacy, and waiting area in Turkey; cardiology and ICU in the US. While the ICU symbol showed a low comprehension percentage in all three countries, the cardiology, immunization, and pharmacy symbols were comprehended very differently depending on the country.

Table 1

Cross tabulations of universal healthcare symbol comprehension (unit: % of correct responses reported).

	<i>Bill</i>	<i>Card</i>	<i>Emer</i>	<i>Fami</i>	<i>Immu</i>	<i>ICU</i>	<i>Lab</i>	<i>Medi</i>	<i>Ob</i>	<i>Pedi</i>	<i>Phar</i>	<i>Radi</i>	<i>Surg</i>	<i>Wait</i>
USA	82	35	98	85	85	53	97	87	82	87	97	100	92	82
Turk	83	77	83	97	77	70	92	70	85	67	20	95	83	62
Kor	73	43	92	27	18	52	75	53	87	52	23	92	72	63
Total	79	52	91	69	60	58	88	70	84	68	47	96	82	69

Cross tabulations with Chi-square tests in Table 2 show the relationships between healthcare symbol comprehension and countries. The test results showed that ten symbols (cardiology, emergency, family practice, immunization, laboratory, medical records, pediatrics, pharmacy, surgery, and waiting area) have significant relationships with countries. The associations of countries with symbol comprehensions were of moderate to strong strength in some symbols: the country that the participant lived in accounted for 37% of the variance in the score on comprehension of the immunization symbol, 45% of the variance in the score on comprehension of the family practice symbol, and 50% of the variance in the score on comprehension of the pharmacy symbol. While people in the U.S. and Turkey comprehended the immunization and family practice symbols relatively easily, people in Korea had difficulty understanding it correctly. For the pharmacy symbol, only people in the U. S. understood the symbol easily.

The waiting area symbol was identified correctly by a large majority for American respondents only (82%), demonstrating a significant association between the country and symbol comprehension. The medical records symbol showed lower comprehension rates

(53%) in Korea compared to the other two countries and the cardiology symbol showed very low comprehension percentages in the U. S. (35%) and Korea (43%), whereas it received a higher comprehension rate in Turkey (77%), again showing a significant association between nationality and its comprehension. Finally, comprehension rates of billing, ob clinic, and radiology did not show any significant difference across nationality (all of those three symbols were identified by the respondents in all three countries with high percentages).

Table 2

Cross-country comparisons with chi-square tests for universal healthcare symbol comprehension (χ^2 (2, N=180)).

	<i>Bill</i>	<i>Card</i>	<i>Emer</i>	<i>Fami</i>	<i>Immu</i>	<i>ICU</i>	<i>Lab</i>	<i>Medi</i>	<i>Ob</i>	<i>Pedi</i>	<i>Phar</i>	<i>Radi</i>	<i>Surg</i>	<i>Wait</i>
χ^2 ,	2.11	23.36	8.37	79.54	65.79	5.07	14.40	15.87	.59	17.10	90.54	4.97	8.29	6.90
<i>p</i> ,	.35	.000	.015	.000	.000	.079	.001	.000	.744	.000	.000	.083	.016	.032
Φ	.11	.36	.22	.67	.61	.17	.28	.30	.06	.31	.71	.17	.22	.20

Pearson's Chi-square tests (2x2) and Fisher's Exact Tests were conducted to examine the relationship between healthcare symbol comprehension and gender (Table 3) and no statistically significant relationship were found both in total and in the data collected in each country.

Table 3

Cross-gender comparisons with chi-square tests for universal healthcare symbol comprehension (χ^2 (1, N=180)).

	<i>Bill</i>	<i>Card</i>	<i>Emer</i>	<i>Fami</i>	<i>Immu</i>	<i>ICU</i>	<i>Lab</i>	<i>Medi</i>	<i>Ob</i>	<i>Pedi</i>	<i>Phar</i>	<i>Radi</i>	<i>Surg</i>	<i>Wait</i>
χ^2	1.67	.022	.274	.655	.093	.206	.83	.95	.000	3.11	2.23	.52	3.80	.10
<i>p</i>	.197	.881	.60	.418	.76	.65	.36	.33	1.00	.078	.135	.72*	.051	.75
Φ	.096	.011	.04	.060	.023	.034	.07	.07	.000	.13	.11	.054	.145	.024

*: *p*-value from Fisher's Exact test

Pearson's Chi-square tests (2x2) were conducted to examine the relationship between healthcare symbol comprehension and age (Table 4). The two younger aged groups ranging

between 18 and 50 years were combined as they showed similarities in results and 2x2 Chi-square tests were conducted. Some statistically significant relationships were found between symbol comprehension and the emergency, surgery, and waiting area symbols. The oldest age group (50 years of age or older) had more difficulty comprehending those symbols correctly compared to the younger age groups.

Table 4

Cross-age group comparisons with chi-square tests for universal healthcare symbol comprehension (χ^2 (1, N=180)).

	<i>Bill</i>	<i>Card</i>	<i>Emer</i>	<i>Fami</i>	<i>Immu</i>	<i>ICU</i>	<i>Lab</i>	<i>Medi</i>	<i>Ob</i>	<i>Pedi</i>	<i>Phar</i>	<i>Radi</i>	<i>Surg</i>	<i>Wait</i>
χ^2	3.33	.40	23.19	.84	.42	.94	.10	1.8	.53	2.89	.00	1.05	21.97	8.10
<i>p</i>	.07	.53	.000	.36	.52	.34	.75	.18	.47	.09	1.0	.31	.000	.004
Φ	.14	.53	.36	.07	.05	.34	.03	.17	.05	.13	.31	.08	.35	.21

Note: The mean difference is significant level (α) at the .05 level.

Pearson's Chi-square tests (2x2) and Fisher's Exact tests were conducted to explore the relationship between symbol comprehension and age in each country. No significant relationship was found in the U.S. However, the younger age group showed better symbol comprehension compared to the older age group in Turkey and Korea. The significant relationships between age and symbol comprehension in countries were found for the emergency, surgery, and waiting area signs in Turkey and Korea; and billing, medical records, and OB clinic signs in Korea only.

Logistic regression analyses were performed with symbol comprehension as the dependent variable, and country, age, and a combined age and country term as predictor variables. A total of 180 cases were analyzed for each symbol, and the full model significantly predicted correct symbol comprehension except for the cardiology, intensive care unit, and radiology symbols. Country was a reliable predictor variable for symbols including family practice (Exp(B)=5.56, p =.0005), immunization (Exp(B)=5.60, p =.0005), laboratory (Exp(B)=2.58, p =.021), Ob (Exp(B)=.405, p =.015), pediatrics (Exp(B)=2.07, p =.007), and pharmacy (Exp(B)=5.75, p =.0005). According to the regression test results, the associations of country with symbol comprehensions were of weak to moderate strength; the country that the participant lived in accounted for 2% (billing) to 27% (pharmacy) of the variance in the score on matching of the symbols. While people in the U.S. and Turkey

comprehended the immunization symbol relatively easily, people in Korea had difficulty understanding it correctly.

3.2. The Matching Test

See Table 5 for percentages of success in matching a healthcare symbol to its correct department title in each country. It displays high percentages of success rates in matching compared to the comprehension tests (except for the radiology symbol).

The success rate percentages ranged from 82-100 with exceptions of laboratory (68%) and pharmacy (45%) in Korea and pharmacy (47%) in Turkey. Although successfully identifying the pharmacy symbol increased by at least 20% in both Turkey and Korea, it was still lower than 50%. Cross tabulations with Chi-square tests in Table 6 show the relationships between healthcare symbol matching and countries. The test results showed that matching the billing, cardiology, family practice, immunization, laboratory, and pharmacy symbols to their correct department titles have significant relationships with countries. Please see Table 6 for test results.

Table 5

Cross-country tabulations of universal healthcare symbol matching (unit: % of correct responses reported).

	<i>Bill</i>	<i>Card</i>	<i>Emer</i>	<i>Fami</i>	<i>Immu</i>	<i>ICU</i>	<i>Lab</i>	<i>Medi</i>	<i>Ob</i>	<i>Pedi</i>	<i>Phar</i>	<i>Radi</i>	<i>Surg</i>	<i>Wait</i>
USA	100	93	100	98	97	93	98	100	93	98	98	93	98	98
Turk	97	100	93	100	100	98	100	92	98	95	47	82	98	100
Kor	87	90	98	82	85	96	68	87	98	92	45	87	95	92
Total	94	94	97	93	94	96	89	93	97	95	63	87	97	97

Table 6

Cross-country comparisons with chi-square tests for universal healthcare symbol matching ($\chi^2(4, N=180)$).

	<i>Bill</i>	<i>Card</i>	<i>Emer</i>	<i>Fami</i>	<i>Immu</i>	<i>ICU</i>	<i>Lab</i>	<i>Medi</i>	<i>Ob</i>	<i>Pedi</i>	<i>Phar</i>	<i>Radi</i>	<i>Surg</i>	<i>Wait</i>
χ^2 ,	13.41	15.53	5.65	19.99	14.79	4.08	38.64	8.31	6.10	4.04	48.77	7.37	4.05	8.24
<i>p</i> ,	.009	.004	.227	.001	.022	.395	.000	.081	.192	.401	.000	.118	.400	.083
ϕ	.27	.29	.22	.33	.29	.15	.46	.22	.18	.15	.52	.20	.15	.21

Note: The mean difference is significant level (α) at the .05 level.

3.3. The Judgment Test

The reported percentages were averaged for each of the groups that varied by age, gender, and nationality.

Table 7

Cross-country comparisons with ANOVA for the judgment test.

Symbol	Mean percentages (and <i>SDs</i>) for each symbol				df	F	p	η^2	95% CI _{diff} ¹
	USA	Turkey	Korea	Total					
American Emergency	95 (7.7)	62 (30.6)	29 (28.7)	62 (36)	2	103.8	.000*	.54	[56, 67]
Korean Emergency	16 (17)	26 (25)	89 (19)	43 (38.6)	2	218.8	.000*	.71	[38, 49]
Turkish Emergency	7 (10.6)	52 (30.6)	1.3 (3.6)	20 (29.7)	2	131.7	.000*	.60	[16, 25]
American Radiology	83 (15.6)	80 (21.7)	84 (19.3)	82 (19)	2	.63	.53	.007	[80, 85]
Korean Radiology	52 (26.4)	55 (33)	49 (29.3)	52 (29.6)	2	.47	.62	.005	[48, 56]
American Pharmacy	89 (12.6)	21 (29.1)	25 (28)	45 (39.7)	2	147	.000*	.62	[39, 51]
Korean Pharmacy	60 (30)	35 (32.2)	81 (28)	58 (35.2)	2	33.5	.000*	.27	[53, 64]

¹CI = confidence interval. Estimations for understandability of signs were from low 0% to high 100%.

* $p < 0.0005$

Nationality influenced responses to all three of the emergency symbols and both of the pharmacy symbols significantly. Koreans thought that, on average, 89% of the public in

Korea would correctly identify the Korean emergency symbol. However, the average ratings dropped to 29% for the American emergency symbol and 1.3% for the Turkish emergency symbol. Surprisingly, Turks rated the American emergency symbol the highest (62%) followed by the Turkish (52%) and Korean (26%) emergency symbols. Americans rated the American emergency symbol the highest (95%) followed by the Korean (16%) and Turkish emergency (7%) symbols. None of those three emergency symbols received consistently high percentages from all three countries. The radiology symbols did not significantly receive different percentage ratings from Americans, Turks, and Koreans. The American radiology symbol received higher than an 80% rating from each country. None of the pharmacy symbols consistently received high percentages across all three countries.

All of the three symbols that are used in the U.S. received higher than 80% ratings from the American respondents. Koreans rated the emergency and pharmacy signs that are used in Korea higher than 80%. Among all seven signs used in the test, the only sign that is used in Turkey is the Turkish emergency symbol, which did not receive average ratings higher than 55% from any of the three groups of respondents.

A one-way between-subjects ANOVA test results revealed a statistically significant effect of nationality on all emergency and pharmacy symbols. See Table 7 for effect sizes.

4. Discussion

Although the universal healthcare symbols were initially developed for individuals with various cultural backgrounds, this study found that some universal healthcare symbols were comprehended with variances depending on the country in which the respondent resided. The comprehension test and cross-tabulations of its results demonstrated that Americans comprehended universal healthcare symbols that were used in this study better than Turks and Koreans did. Those symbols were developed by an American institution, which might have influenced the results. Therefore, the country individuals reside in may affect the comprehensibility of healthcare symbols. In the comprehension test, the billing, ob clinic, radiology, emergency, laboratory, and surgery symbols were identified correctly by at least 70% of the respondents in each of the three countries. Neither logistic regression nor Pearson's Chi-square tests found any significant differences between nationality and the comprehension of the first three of those symbols (billing, ob clinic, and radiology). These results suggest that universal healthcare symbols can be understood cross-culturally, supporting Olmstead's (1999) findings.

Results from logistic regression of the comprehension test showed that the country in which a respondent lives can be a factor that influences comprehension of a healthcare symbol such as pharmacy, immunization, and family medicine. The pharmacy symbol used in this study is widely used in the U. S., and many of the American respondents were familiar with it, depicting a bottle-shaped pill container. The symbol was rarely comprehended among

people in Turkey and Korea, because those countries use different types of medicine containers. In Turkey, the official sign for pharmacy includes the letter “e” in a square frame, which is the initial for the word pharmacy in Turkish (eczane). This sign is required to be used at all pharmacy shops in Turkey, making the Turkish respondents unfamiliar with any other pharmacy signs. Some Turkish respondents confused the pharmacy symbol with the radiology symbol since R in the pharmacy symbol was confused with R in radiology. Korean people had a difficult time understanding what the immunization symbol meant, because in Korea, injection is popularly practiced in family medicine and pediatrics; there is no need to identify the symbol. At usual visits to the hospital, Koreans may receive injections of various medicines. Also, there is an injection room next to the exam room in most doctors’ offices such as pediatrics and internal medicine. Thus, Koreans did not think the injection shape meant an immunization sign. The family medicine symbol was another example that Korean respondents had difficulty identifying correctly. Many Korean respondents thought it was a consulting room or information desk where various types of visitors gather. In comparison to Koreans, Turkish respondents comprehended the family medicine symbol correctly. This is probably due to recent policies in the Turkish health industry which promote family medicine through campaigns and regulations. The pediatrics symbol was not comprehended easily by the Korean and Turkish people. Many people answered that it was an animal clinic, and some respondents associated the symbol with non-medical environments such as a children’s playground. According to the Pearson Chi Square tests, cardiology, emergency, laboratory, medical records, surgery, and waiting room are other signs that were found to be associated with nationality. The cardiology symbol was not identified correctly by the majority of the respondents in the U. S. and Korea. However, a majority of the Turkish respondents identified the symbol correctly as cardiology. Many American and Korean respondents identified the cardiology symbol as heart monitor, EKG, or defibrillator. They may have thought that it meant a place where they could use those equipments.

The emergency symbol that was used for the comprehension test was identified correctly by the majority of the respondents in all three countries. This symbol had the second highest average percentage of comprehension after the radiology symbol. The emergency symbol is widely used in American movies and shows, which has an international audience. The symbol includes “emergency” in text form, making it easier to identify the sign for those who know English. However, despite high percentages of comprehension of this symbol in all three countries, the Pearson’s Chi-square test results indicated that there is a significant relationship between nationality and the responses to this symbol. There is a 15% difference between the highest and lowest percentages of comprehension for this symbol between the rates of correct responses from the U.S. and Turkey. As it was expected that this symbol would be known by many Americans, the Turkish and Korean respondents’ lesser familiarity with American media and lesser knowledge of English may have caused the difference.

The “medical records” symbol received very different rates of correct responses from the three groups of respondents. The symbol was identified correctly by the majority of the respondents in the U.S. (87%) and Turkey (70%) and by about half of the Korean respondents (53%). Some of the Turkish respondents identified the symbol as a room or cabinet where medical supplies or equipment are stored. Medicine storage and pharmacy were some of the alternative responses that Korean respondents provided for the medical records symbol. The responses to this symbol from the three countries exemplifies how cultural background or nationality influences perception of a symbol. In Turkey, patients usually do not interact with medical staff through their own medical records. On the contrary, American patients can ask for a copy of their records for employment reasons or for their own records. These results may indicate the differences that exist across countries regarding healthcare services and their purposes.

Surgery and its comprehension had a significant relationship with nationality despite being identified correctly by the majority of the respondents in all three countries. The symbol was interpreted by some Korean respondents as a doctor’s office, patient’s room, or examination room. Some Turkish respondents identified the symbol as patient care instead of surgery. Finally, waiting room was identified correctly by a high percentage of American respondents (82%). However, less than 65% of Korean and Turkish respondents identified it as waiting room. Both Turkish and Korean respondents identified the symbol as a reading or rest area. Those results support Brugger’s (1999) statement that symbols can be misunderstood across cultures.

While gender did not show any significant association with symbol comprehension in the comprehension test, age did have a significant association with healthcare symbols including emergency, surgery, and waiting room. The symbol includes an English word that mostly older people in those countries would not be able to read because English has become more and more popular around the world in the recent decades as a result of increased globalization and the media effect. Thus, the younger generations are more likely to learn English at a school age compared to the older generations. For the surgery symbol, many older people in Turkey and Korea misunderstood it as a patient room. For the waiting room symbol, some older respondents in Turkey and Korea answered that it was a reading room, as the symbol shows a person who is reading.

Based on statistical analyses of Chi-square tests in the comprehension and matching tests and logistic regression of the comprehension tests, there were commonly shared results that the country in which a respondent resides is associated with the correct comprehension of healthcare symbols, including family practice, immunization, laboratory, and pharmacy. This result provides important information for designers: symbol design should consider cultural diversity so that symbols can be comprehended universally. It also shows that it is a great challenge for designers to devise universal symbols which can be understood accurately by

people of various cultural backgrounds.

Results from the judgment test revealed that it is very certain that people comprehended symbol design from their own country significantly better. This result supports the comprehension and matching tests' results. In addition, previous studies indicated that the judgment test predicted the comprehension test results (Brugger, 1999; Foster & Afzalnia (2005); Young & Wogalter, 2001). The matching test results support that familiarity influences understanding of a symbol. Promoting simple and easily identifiable universal healthcare symbols in different countries and making the public familiar with them can increase their comprehensibility. The matching test results also support Gakopoulos (2009) and Cogwill and Bolek's (2003) suggestions that symbols can be learned and should be explained to the public.

A lack of familiarity with most of the symbols that are included in this study may have influenced the results. For example, the emergency symbol is widely used on ambulances, creating familiarity for many Americans, which would explain why 98% of Americans understood it. However, 100% of the American respondents understood the radiology symbol correctly, although it is not used commonly in the country. This indicates that, although familiarity influences the comprehensibility of healthcare symbols, clear and effective symbol design can be understood by users easily regardless of their familiarity with the symbol. The respondents' varying familiarity with healthcare departments and services is another limitation of this study. The older generation might be more familiar with particular hospital services compared to the younger generation. For more comprehensive results, data should be collected from more countries and from larger samples.

With this study, we aim to contribute to the development of universal healthcare symbols to improve the experiences of healthcare facility visitors from different cultural and linguistic backgrounds. The results indicate that it is possible to develop universal symbols that can be used in different countries, and there is a need to develop and test universal healthcare signs. Some of the signs that were used in this study were identified correctly by the majority of the respondents from all three countries, supporting the possibility of cross-cultural comprehensibility of healthcare symbols. However, many symbols did poorly in one or two of the three countries, revealing a need for designing better symbols that would address people with different nationalities and cultural backgrounds. As mentioned by Foster and Alfanzia (2005), meanings of symbols can be interpreted differently in different cultures, and it is difficult to conclude that a symbol's comprehension depends on the symbol itself. Designers need to pay more attention to the cultural limitations of symbol interpretation. It is critical to develop healthcare symbols that can be comprehended universally as symbols, such as emergency, which can directly impact people's lives and health. This study suggests that universal healthcare symbols should be tested in different countries to make sure they can be comprehended across countries.

5. Conclusion

Comprehension test results revealed that some signs can be comprehended in all three countries with high percentages. However, testing of some other signs revealed significant differences of sign comprehension across the three countries. The matching test results indicated that familiarity may increase the comprehension of signs. Explaining signs to the public or using the same standard signs over time can increase their comprehensibility by the healthcare setting visitors. Although gender did not have a significant influence on sign comprehension, age had a significant relationship with correctly identifying some of the signs. Further research is necessary to understand the relationship between age and sign comprehension. The judgment test results revealed that there is significant relationship between predicting signs correctly and nationality. Such results support that it is possible to develop universal healthcare signs that can be understood by people of different cultural and linguistic backgrounds. The results also support that some symbols can be interpreted very differently in different cultures. Thus, it is necessary to test symbols across countries in their development process. It is possible to develop and test universal symbols that can be used in different countries; however, designers should consider cultural limitations of sign interpretation in their design process.

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