

An Empirical Analysis of the Perception of Mobile Website Interfaces and the Influence of Culture

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Abstract. The persuadability and credibility of a website depend on users' perception and interpretation of the various design elements that characterize its user interface. While so much has been done in the web domain to investigate the role culture plays in the perception of websites and the need for personalization along cultural lines, very little has been done in the mobile domain to uncover the differences that exist between the Western and African cultures. To bridge this gap, we carried out a quantitative study among 233 subjects to investigate how the perceptions of four systematically designed mobile websites 1) vary between these two cultures using Canada and Nigeria as a case study; and 2) can be leveraged for tailoring mobile websites for both groups. Our findings show both cultures differ in their perceptions of mobile websites with respect to aesthetics, usability, and credibility, with the Nigerian group being less critical in its judgment and more attracted to colorful websites.

Keywords: mobile website, user interface design, visual, layout, color, aesthetics, usability, credibility, culture, localization, persuasion.

1 Introduction

E-commerce is growing every day by leaps and bounds, especially with the advancement in mobile technology and the coming of more businesses and people online. Shoppers can now make online purchases from anywhere at any time by using their mobile phones without having to be physically present in a brick-and-mortar store. E-commerce had been predicted to overtake traditional commerce in years to come [27], with pundits projecting that by 2019 online sales would more than double to \$3.551 trillion as more people come online [17]. However, in today's highly competitive market, online sellers can only increase their shares if they understand how to effectively persuade users to use their websites for the purchase of products and services. In other words, they can only succeed if users perceive their websites as credible [8]. Fogg [9] defines perceived credibility as believability based on perceived trustworthiness and perceived expertise. In the case of websites, this is reflected by the user interface (UI). He claims it gives website designers the power to change users' attitudes

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and behaviors, e.g., influencing them to think positively about the site owner or return to the site often.

Research has shown that UI design elements that border on visuals, navigation and color play a major role (rhetorical in nature) in the persuasive process [28]. The first of Fogg's ten guidelines for designing a credible websites states "*design your site so it looks professional (or as appropriate for your purpose)*" as "*people quickly evaluate a site by visual design alone*" (p. 19). The seventh guideline states "*make your site easy to use and useful*" (p. 26), as a website loses credibility whenever users find it difficult to accomplish a task with it [7]. Thanks to the small screen size of the mobile device, designing for usability on the mobile platform has become even more important in order to foster an enduring user experience that may motivate the user to return to a website. According to Winn and Beck [28], "*design elements appeal to a shopper's logic, emotions, and assessment of credibility*" (p. 1). Further, Fogg [8] posits that the assessment of the credibility of a website depends on the "prominence-interpretation theory," which relates UI elements to the perceived credibility of a website. This theory explains what transpires when a user uses a website: 1) the user notices the UI elements of the site (prominence); and 2) the user makes a judgment about them (interpretation). Among the factors affecting prominence are the involvement of the user, the topic of the website, task of the user, experience of the user and individual difference. Of these, user involvement may be the most dominant factor which affects prominence. On the other hand, among the factors affecting interpretation are the assumptions in a user's mind, skill and knowledge of the user and context of the user. According to the theory, both must happen for credibility assessment to occur; otherwise, credibility assessment does not take place. Furthermore, the interpretation component posits that different users interpret identical website elements in different ways due to the role culture plays in the judgment making process [8]. This brings us to the focus of this paper: the need for localization of mobile websites to meet the preferences of local users in order to increase its persuasive power [9]. Localization refers to the adaptation of "*products and services to a particular language, culture and desired local look and feel*" (p. 1), in order to maximize user experience and satisfaction [4]. To realize this, research [8,9] has shown, the cultural background, values, and attitudes of the targeted audience ought to be taken into account when designing mobile websites.

Though a lot of work [4], [8], [21], [25] has been done on the role culture plays in the judgment of a website, very few studies have focused on the mobile domain [18]. Moreover, little is known about the differences that exist between the Western culture, where most e-commerce websites are designed, and the African culture, a key player in the e-commerce supply chain, with the aim of localizing them accordingly. Thus, we conducted an online survey among 233 subjects (146 Nigerians and 87 Canadians) to investigate the differences that might exist. We asked participants to assess four systematically modified mobile web designs (with different levels of UI treatments) based on aesthetics, usability and credibility. We chose Nigeria because, apart from being the most populous in Africa with over 170 million people, it has become one of the leading online retailers and currently has the highest number of mobile phone users [22]. At the start of 2014, for example, it had over 11 million

Facebook users, which was the highest on the continent [10]. This makes it a candidate country of choice for a study of this nature that aims to uncover how Africans perceive mobile websites for better personalization. Owing to the well-known differences based on culture, levels of education [15], internet experience [21], etc., that exist between these two countries, we hypothesized that the Canadians will be more critical in assessing mobile websites and less attracted to colorful websites than the Nigerians.

The rest of this paper is organized as follows. Section 2 focuses on related work. Section 3 explains the research method used. Section 4 and Section 5 dwell on result and discussion respectively. Finally, Section 6 focuses on conclusion and future work.

2 Related Work

Research [8], [21], [25] has shown that culture impacts users' perception of websites, as different cultures have different UI design preferences and ways of organizing and structuring information. For example, regarding web content layout, a country like France is suggested to prefer a centered orientation. Cyr and Trevor-Smith [8] found that Japanese and Germany/United states differ in the way they position banners in websites. Asians and Americans have also been shown to differ in the way information is organized in a website. Moreover, with regard to color, cultural differences have also been found to exist in terms of connotation and preferences. For example, Cyr and Trevor-Smith [4] reported that while the color red may be used to express joy in China, it is used to express a warning in the United States. Visual interpretation and preference have also been found to vary across cultures. Thus, according to Cyr and Trevor-Smith [4], it is important that images in websites be tailored to the local audience. They argued that the use of culturally relevant as well as non-offensive images makes a user feel comfortable and understand easily the meaning of the images presented on the website, which eventually leads to greater user satisfaction, as found by Sun [25]. In a visual-related study, the author showed that both the Chinese and Brazilian participants were pleased with the natural images drawn from their respective cultural environments. In summary, Sun recommends that for high-context (HC) cultures, "implicit" cultural markers, such as visuals and colors, should be used; while for low-context (LC) cultures, "explicit" cultural markers, such as page layout, should be used.¹ For example, LC cultures, such as Germany, were found to prefer a hierarchical and verbal websites, such as well-structured and logically laid-out websites with information organized alphabetically. In contrast, HC cultures, such as China and Brazil, were found to prefer visuals and colors [25]. Moreover, Reinecke and Bernstein [21] argued that interfaces that are automatically adapted, based on the entirety of a user's multi-faceted national culture, would match the user's preferences better. They proposed a design approach for automatically adapting UIs based on a

¹ A HC culture is that with a communication style where so much is left unsaid and to be inferred from the context, while a LC culture is that where everything is clearly communicated.

user's predicted culture, calculated based on his/her residence history. The implemented prototype was about 60% to 70% accurate in predicting users' UI preferences. However, few studies exist showing how users from the African continent (e.g., Nigeria) perceive the various UI designs and visual elements of a mobile website and how this differs from users from a Western culture with the aim of personalization and adaptation for the former. It is this gap this paper attempts to fill by providing empirical evidence that support our hypotheses.

3 Method

3.1 Research Design

The aim of our study is to find out how the Canadian and Nigerian cultures perceive various mobile UI designs, which differ in terms of colors, images and layouts. We applied a UI design framework (Fig. 1), which we called "Mobile Web UI Transformation Framework" or, simply, "Action-Artifact (A²) Framework", to systematically modify the UI design of four hypothetical webpages adapted from existing websites in the market.² The axes represent the actions (UI treatments) performed to realize a new artifact (UI) in the next quadrant. We regard the two blue-theme UIs below the x-axis as *high-level* web designs and the two above as *low-level* web designs. Starting from the low-level group in a clockwise direction, we perform a compound UI treatment (*make gray and add icon*) on A to produce B. Next, we perform a simple UI treatment (*make unicolor*) on B to produce C. This UI transformation continues till we return to A from where we started. Further, based on the four UIs, we hypothesized as follows:

H1: Canadians will be more critical than Nigerians in judging mobile websites.

H2: D will be judged as the best by both Canadians and Nigerians.

H3: A and B will be judged as the worst by Canadians and Nigerians respectively.

Our first hypothesis (H1) was hinged on the fact that both countries differ in terms of education and mobile internet experience [15], with Canada ranking higher as a developed country than Nigeria, which is a developing country. So, it is very likely the perception of mobile websites by Canadians will be more sophisticated than Nigerians, as the former are more likely to have higher expectations given their higher level of education and mobile experience. In our second and third hypotheses (H2 and H3), we surmised that Mobile Web D (for brevity, D) would be judged as the best by both groups for two reasons: aesthetic appeal and layout. We felt D is the most beautiful given its appeal, professional look and feel (its blue color theme) and grid layout (easier to use).

² All four websites were adapted from existing tourism and travels' mobile websites in the market in 2014, namely, m.wakanow.com, mobile.united.com, mobile.utah.com and tourismwinnipeg.com. Note: as of the time of writing this paper, some of them had been redesigned.

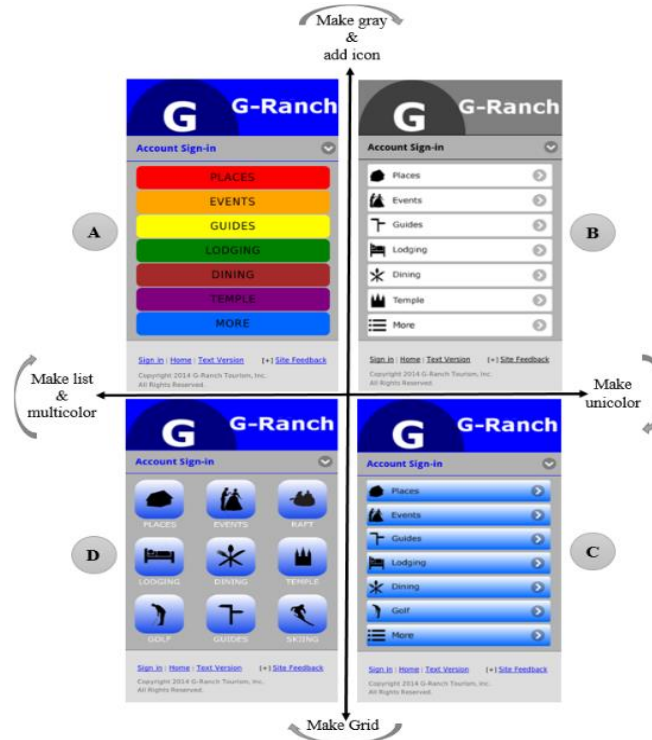


Fig. 1. Mobile web UI transformation framework

For example: 1) it is less prone to mistakes when an item of interest is clicked; and 2) all items are displayed at once: no extra layer of navigation is added by having to click “More...” to access more items, as is the case in the list layout. Thus, we surmised that the better usability perception of D would increase its aesthetic perception thanks to the halo effect [19]. As a result, it would be preferred to C, with which it shares a similar look and feel. Finally, we surmised that between the two low-level designs, A would be judged the worse by the Canadian group (CG), while B by the Nigerian group (NG). The reasons are: 1) given that the CG belongs to a LC culture [12], [20], it is likely to prefer a *more professional* (grayscale) website to a colorful website that is *less professional*, as research [25] has shown that LC cultures are more concerned with information organization than visuals and colors; and 2) given that the NG belongs to a HC culture [12], [20], which, research [25] has shown, likes colorful and visually appealing websites, it is likely to prefer a website that uses *attractive* colors to one that uses *gray*.

3.2 Measurement Instruments

Existing validated instruments were used to measure the three constructs of interest. Aesthetics was measured using Schaik and Ling’s 6-item version [23], as adapted

from Lavie and Tractinsky's aesthetics instrument [16]. This version has been previously validated [2], [24]. Usability was measured using Lavie and Tractinsky's usability 5-item scale [16] as adapted and validated by previous studies [24], [26]. The items in both instruments were measured on a 7-point Likert scale ranging from *Strongly Disagree (1)* to *Strongly Agree (7)*. Credibility was measured using a single-item scale [24], ranging from *Very Bad (1)* to *Very Good (7)*. Finally, the four webpages were subject to forced ranking from *Most Credible (1)* to *Least Credible (4)*, which was reversed during data analysis. In the survey, the webpages were presented to participants in this order (C, A, B, D), with the aesthetics and usability Likert-scale items randomized.

3.3 Participants

The survey was approved by the University of Saskatchewan Research Ethics Board. Thereafter, it was posted on the university's website and Facebook for anonymous participation. Also, invitation emails were sent to volunteer participants for a chance to participate. In order to appreciate participants for their time, they were given a chance to optionally enter for a draw to win one of our four gift cards worth \$50 each. The data gathering lasted for a period of six months. About 300 subjects participated in the study.

After excluding participants who did not meet our inclusion criteria, we were left with 87 (37.3%) Canadians and 146 (62.7%) Nigerians for our analysis. Table 1 shows the demographics of participants: 54.5% males and 45.5% females. 67.8% were between the age of 18 and 24 years while the other 32.2% were above. 75.5% of them had up to 10 years and above of internet experience. Lastly, 57.9% had high school qualification; 24.5% had a bachelor while 8.2% had a postgraduate qualification.

Table 1. Participants' demographics

Criterion	Group	Canada	Nigeria	No.	Percent
Gender	Male	19	108	127	54.5%
	Female	68	38	106	45.5%
Age	18-24	48	110	158	67.8%
	>24	39	32	71	30.4%
	Unidentified	0	4	4	1.7%
Years on Internet	<10	10	47	57	24.5%
	>=10	77	99	176	75.5%
Qualification	High School	35	100	135	57.9%
	Bachelor	37	20	57	24.5%
	Postgraduate	10	9	19	8.2%
	Others	5	17	22	9.4%

4 Results

4.1 Reliability Measurement

The reliability test for the aesthetics and usability scales was based on McDonald’s coefficient omega (ω) rather than the traditional Cronbach’s coefficient alpha (ρ), which is inappropriate as a measure of internal consistency when the collected data does not follow a normal distribution or meet the tau-equivalent model’s restrictive and unrealistic assumptions, e.g., equality of true score variance across all items in a scale. More important, ω does not only provide a single-point estimate, it provides, unlike ρ , a confidence interval (CI) as well [5]. Table 2 shows the result of the test at 99% CI based on 5000 bootstraps. The reliability requirement, $\omega > 0.7$, for both scales is met.

4.2 Construct Performance

To visualize how both groups’ perceptions of aesthetics and usability changed, alongside credibility rating and ranking, within and between groups, we assumed our ordinal scale was an interval scale to enable us to compute a point estimate (overall mean score or performance) for each construct (latent variable), which could be plotted in a graph (see Fig. 2). We deliberately computed the means of the credibility rating and credibility ranking (Likert-type items), meant to be statistically analyzed using the mode, median and/or frequency only [14], in order to visualize on the same plot how these single-item measures change, alongside the multiple-item constructs, within and between groups. This would not be possible if we were to use the mode or median value, which may be the same within group (see Table 3). For example, the credibility rating median for the NG happens to be the same (i.e., 6) for all four webpages (A, B, C and D). First, the mean score of the composite items for each participant was calculated to arrive at a single-column value for each Likert scale. Second, the overall mean score of each of the two transformed Likert-scale constructs (aesthetics and usability) and the mean of the Likert-type items (credibility rating and credibility ranking) for all participants were calculated to arrive at point estimates. Third, these point estimates (overall mean scores) were plotted on a graph as shown in Fig. 2.

Table 2. Construct reliability test

Webpage	Construct	Omega	Conf. Interval
A	Aesthetics	0.93	[0.91, 0.95]
	Usability	0.91	[0.87, 0.95]
B	Aesthetics	0.92	[0.89, 0.94]
	Usability	0.91	[0.86, 0.94]
C	Aesthetics	0.91	[0.89, 0.94]
	Usability	0.91	[0.84, 0.95]
D	Aesthetics	0.91	[0.87, 0.93]
	Usability	0.94	[0.91, 0.96]

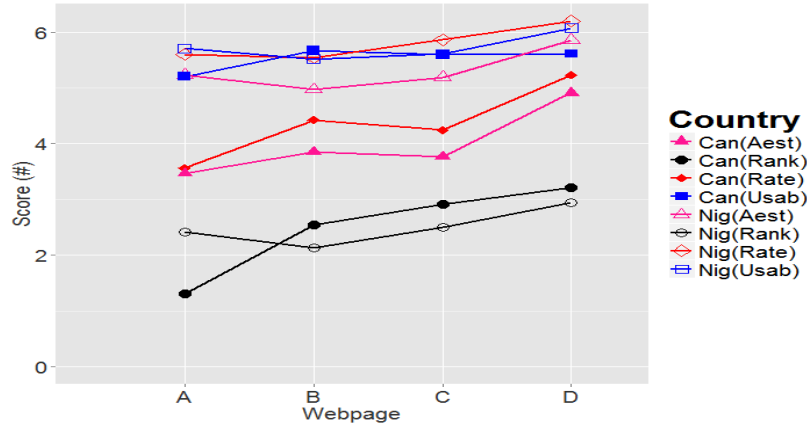


Fig. 2. Mean performance of rating and ranking measures

For the most part, we find that the NG rated the four webpages, especially with respect to aesthetics and credibility rating, higher than the CG, except with respect to credibility ranking which was forced. For example, with respect to aesthetics, the mean rating by the NG and CG regarding A are 5.23 and 3.47 respectively. When the UI design is changed from a multicolor theme (A) to a grayscale theme (B), the rating by the NG decreases to 4.97, while that by the CG increases to 3.85. Further, when the UI design is changed from a grayscale theme (B) to a blue theme (C), the mean rating by the NG increases to 5.19, while that by the CG decreases to 3.77. Finally, when the UI layout is changed from a list (C) to a grid (D), the mean rating by both groups increases simultaneously to 5.86 and 4.91 respectively, which happen to be the highest performance for aesthetics among all four webpages.

It is interesting to note how, for both groups, except for the usability rating of the CG, the mean performances of all four measures change in sync across all four webpages, suggesting the performance of one or more measures (e.g. aesthetics) must have informed the others (e.g., credibility), as found by previous studies [3], [7]. However, this needs to be further verified by more analysis, e.g., correlation or path model analysis, which is not the focus of this paper. At the moment, we are only concerned with investigating how the perceptions of aesthetics, usability and credibility vary between the two groups and not how these constructs influence one another. This leads us to the between-group analysis in subsection 4.3. Further, we notice that the CG ranked D, C, and B moderately higher (due to forced ranking), but A markedly worse, than the NG. This suggests that while the NG might be relatively pleased with A as evident in its third-place performance with respect to all four measures, which are in sync, the CG was not, as evident in A having the worst performances among all four webpages.

4.3 Between-group Significance Test

We carried out non-parametric Kruskal-Wallis rank sum test on the transformed aesthetics and usability single-column mean scores and the raw credibility rating and ranking scores to determine whether the differences between the two groups were statistically significant. We chose the non-parametric test instead of ANOVA because the Likert-scale/type items in our dataset were not normally distributed as characteristic of most survey data [14]. Table 3 shows the median and mean of the transformed Likert scales and Likert-type items and the result of the significance test.³ It shows that the group differences with respect to aesthetics and credibility rating are significant at $p < 0.0000$. This indicates that both groups significantly differ, with the CG being more critical of all four webpages. Similarly, with respect to usability, the group difference regarding A's and D's ratings is significant at $p < 0.05$, but that regarding B and C is not. This is evident in the plot in Fig. 2, as we see a relatively large difference between the two extreme webpages (A and D), but not between the middle webpages (B and C). Lastly, with respect to credibility ranking, the group difference is significant at $p < 0.0000$ regarding A, at $p < 0.05$ regarding C, nearly significant at $p = 0.08$ regarding B, but not significant regarding D. To account for these differences and non-differences between the two groups, we decided to plot the credibility ranking of the webpages by participants in order to have a clear insight into how the two groups' rankings are distributed. Fig. 3 shows the plot. By a glance, we notice in the plot that both groups, to a great degree, ranked D in a similar way. We discover that about 50% of both groups ranked D as *most credible*. Further, we notice that the CG ranked D as *second most credible* and *third most credible* more than the NG. However, this does not result in a significant difference between both groups as this is offset by the more than 50% of the NG (53%) that ranked D as *most credible* compared to 48% of the CG. On the flip side, we find that both groups clearly differ in the ranking of A. About 80% of the CG (69 out of 87) ranked A as *least credible* while only about 32% of the NG (47 out of 146) ranked it as *least credible*. On the other hand, only about 0% of the CG (1 out of 87) ranked A as *most credible*, while about 24% (35 out of 146) ranked it as *most credible*. This suggests that almost all the CG participants were highly displeased with A, but this was not the case with the NG. However, the reverse seems to be the case regarding B, which is nearly significant at $p = 0.08$. Only about 16% of the CG (14 out of 87) ranked B as *least credible*, while 34% of the NG (50 out of 146) ranked it as *least credible*. On the other hand, about 24% of the CG (21 out of 87) ranked B as *most credible*, while only about 8% (12 out of 146) ranked it as *most credible*. This suggests that the CG preferred a professional-looking mobile website with fewer colors over a highly colorful mobile website preferred by the NG.

³ The Kruskal-Wallis rank sum test is based on comparing the medians—and not the means—of the two groups. We showed the mean values of the four measures in Table 3 for the purpose of providing the precise values of the measures in Fig. 2 and not for statistical analysis.

Table 3. Group difference significance test

Webpage	Measure	Mean		Median		Sig.
	Construct	Can	Nig	Can	Nig	
A	Aesthetics	3.47	5.23	3.33	5.50	0.0000
	Usability	5.20	5.70	3.83	6.00	0.0500
	Credibility Rating	3.56	5.60	4.00	6.00	0.0000
	Credibility Ranking	1.31	2.42	1.00	2.00	0.0000
B	Aesthetics	3.85	4.97	3.83	5.33	0.0000
	Usability	5.67	5.52	5.80	6.00	n.s
	Credibility Rating	4.43	5.54	5.00	6.00	0.0000
	Credibility Ranking	2.55	2.14	2.00	2.00	0.08
C	Aesthetics	3.77	5.19	3.67	5.50	0.0000
	Usability	5.60	5.60	5.80	6.00	n.s
	Credibility Rating	4.24	5.86	5.00	6.00	0.0000
	Credibility Ranking	2.92	2.50	3.00	2.50	0.0500
D	Aesthetics	4.91	5.86	5.00	6.00	0.0000
	Usability	5.61	6.07	5.80	6.00	0.0100
	Credibility Rating	5.22	6.20	5.00	6.00	0.0000
	Credibility Ranking	3.22	2.94	3.00	4.00	n.s

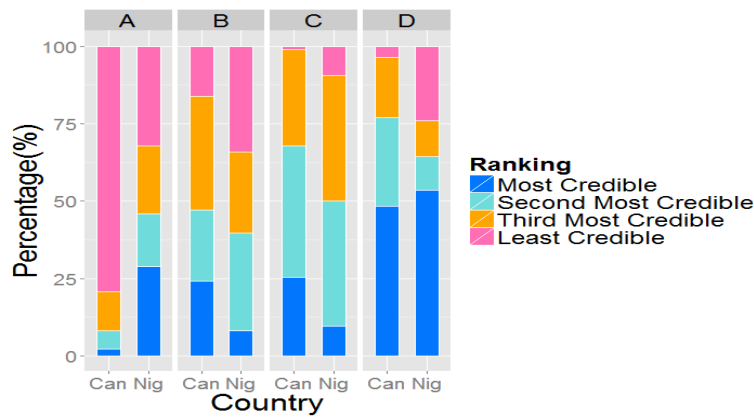


Fig. 3. Credibility ranking based on country

5 Discussion

The results we have presented, to a great degree, validate all of our hypotheses. Our first hypothesis was *Canadians will be more critical than Nigerians in judging mobile websites*. Table 3 and Fig. 2, especially with respect to aesthetics and credibility, confirm this hypothesis. The ratings of the four websites by the Canadians, for the most part, are lower than those by the Nigerians. A possible explanation is that the Canadians are more educated and had more internet experience. For example, 54% and 89%

of the Canadian participants had bachelor/postgraduate qualifications and 10 years and above of internet experience respectively, while only 20% and 68% of the Nigerian participants had similar qualifications and experience respectively. Another factor that might be responsible is that the Canadian group had more female participants (78%) than male participants (22%), while the Nigerian group had more male participants (74%) than female participants (26%). Generally, females are known to be more critical of websites than males [6]. However, to ensure that this was not the (only) factor that actually accounted for the differences, we additionally performed a between-group analysis between the respective males and females of both groups. The result showed that this was not the factor that was responsible, as the Canadian male and female groups turned out to be more critical than the Nigerian male and female groups respectively. Moreover, analyzing the participants' comments, from a qualitative standpoint (not part of the focus of this paper), also confirmed our quantitative findings. Lastly, the lower rating of the four UIs by the CG than the NG (Fig. 2) indicates that the former may be more conservative and moderate in rating products and services in general than the latter.

Our second and third hypotheses—*D will be judged as the best by both Canadians and Nigerians, and A and B will be judged as the worst by Canadians and Nigerians respectively*—are also supported by our results. Both groups judged the high-level web designs (D and C) in a similar way, with the former judged the best based on all four measures. However, the two groups differed in judging the low-level web designs (A and B). While the CG preferred B, which employed a unicolor scheme (grayscale), the NG preferred A, which employed a multicolor scheme (rainbow). This, in particular, has practical implications. It suggests there is a need to localize the mobile websites designed in one country to meet the local preferences of the users in another country. Thanks to the low-bandwidth problem in Africa [15], one of the aims of this study was to specifically investigate whether the NG might prefer a grayscale website to an overtly colorful website, which may suggest that users from Nigeria may not be so much concerned about aesthetics if every other element in the website is okay. In that case, the text-based version of mobile websites can be rendered on users' browser automatically when the server senses a limited bandwidth on the client browser without seeking their permission or prompting them to make the choice. However, based on our findings, this may not be in the best interest of responsive website owners that do this adaptation automatically, as this might negatively impact perception of users who prefer colorful websites in the long run [15]. In other words, non-colorful websites may not persuade Nigerians to use them as much as colorful websites do, as research has shown that people, generally, say yes to the things they like [1]. Thus, it will be of great benefit to e-commerce vendors if they go the extra mile to personalize their professional mobile websites, which use a black-and-white or grayscale theme, to the Nigerian audience, which are more attracted to colors. This may not necessarily be the case with respect to Canadians, as they still perceive such websites favorably inasmuch every other UI characteristic, e.g., usability, is okay.

Our study has a number of limitations. First, we only sampled the Nigerian and Canadian populations, which may threaten generalizing our findings to the broader Western and African cultures. Second, it adopted a self-report approach based on

users' perception of mobile web UIs rather than actual use. Third, the order of presentation of the four web UIs during the survey could have impacted the way participants responded. Despite these limitations, our findings expand the literature on the perception of mobile websites by providing insight into how the African and Western populations may differ in the perception of mobile websites for the purpose of personalization.

6 Conclusion and Future Work

We have presented how users from the Western and African cultures perceive different mobile website designs and how they differ using Canada and Nigeria as a case study and a sample of 233 participants to enable better tailoring along cultural lines. Our findings show that the two groups differ in the perception of mobile websites, with the Nigerian group being less critical and more persuadable by colorful websites than the Canadian group. However, both groups prefer a grid- to a list-layout mobile website. Our contribution is that our paper provides empirical evidence on how the Western and African cultures are similar or differ in the perception of mobile website designs. This can be leveraged to adapt or personalize mobile website for the latter group. As part of future work, we intend to extend our study to other Western and African countries, as well as other continents, in order to broaden the generalizability of our findings.

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