What Drives Perceived Usability in Mobile Web Design: Classical or Expressive Aesthetics?

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Abstract. Research has shown that the *perceived usability* of a web artifact is influenced by its *perceived aesthetics*: a high-order construct composed of two lower-order dimensions (*classical aesthetics* and *expressive aesthetics*). However, in the mobile domain, where *usability* is very important in human-computer interaction (HCI) given the relatively small screen size of the mobile device, limited research has investigated: (1) which of the two dimensions of *visual aesthetics* is the stronger predictor of the *perceived usability* of a website; (2) how the *classical* dimension impacts the *expressive* dimension; and (3) how culture moderates the relationships among the three HCI design constructs. To address these questions, we conducted a study of the perceptions of four systematically manipulated mobile websites and modeled the relationships between *perceived usability* and the two dimensions of *perceived aesthetics*. Based on a sample of 233 participants (87 Canadians and 146 Nigerians), our models account for 30% to 80% of the variance of *perceived usability*. They show that *classical aesthetics* is stronger than *expressive aesthetics* in predicting the *perceived usability* of a mobile website, irrespective of the level of aesthetic treatment of the user interface and culture, with the effect size being larger for the Nigerian group than for the Canadian group. Moreover, the models reveal that *classical aesthetics* strongly influences *expressive aesthetics*. Our results suggest that what is classical is expressively beautiful and usable. The significance of our findings is that in mobile web, there is need for designers to pay closer attention to *classical aesthetics* given the strong influence it has on *perceived usability*.

Keywords: Mobile web · Classical aesthetics · Expressive aesthetics · Perceived usability · Path model · Effect size · Culture

1 Introduction

The pervasiveness due to the portability, affordability and, above all, personal nature of mobile devices has resulted in various internet vendors moving their businesses and services to the mobile domain. However, owing to the relatively small screen size of mobile devices, making good interface design a challenging task to achieve [11], *usability* has become an important issue in human-computer interaction (HCI) in mobile web. More importantly, research in Technology Acceptance Model (TAM) [27]

A. Marcus and W. Wang (Eds.): DUXU 2017, Part I, LNCS 10288, pp. 445–462, 2017.
DOI: 10.1007/978-3-319-58634-2_33

has shown that *perceived ease of use* (mediated by *perceived usefulness*) predicts users' *intention to use* a mobile website. This makes it important to investigate the antecedents of *perceived usability* in the mobile domain. So far, a number of studies [12, 13] have found that the *perceived usability* (PU) of a website is influenced by its *perceived aesthetics*, an abstract construct comprising two major dimensions: *classical aesthetics* (a more objective dimension) and *expressive aesthetics* (a more subjective dimension). Both dimensions offer "*a finer grained view of perceived aesthetics*" [13, p. 289] in understanding the relationship between *aesthetics* and *usability*. However, limited research has investigated: (1) which of these two dimensions of *perceived aesthetics* predominantly determines the *perceived usability* of a mobile website; (2) how one of the dimensions impacts the other; and (3) what moderating role culture plays. Most prior studies [3, 4, 6, 12, 13] have focused on the web domain on one hand, and Western and Asian populations on the other hand. However, countries in Africa, where "*mobile is fast becoming the primary channel of accessing the Internet*" [7, p. 2], have been practically left out. To bridge this gap, we conducted a study on the perception of four systematically manipulated mobile websites using 233 participants from a high-context culture (146 Nigerians) and a low-context culture (87 Canadians) [10].

Our results reveal that: (1) *classical aesthetics* predominantly determines the *perceived usability* of a mobile website; and (2) the perception of *classical aesthetics* (CA) strongly impacts the perception of *expressive aesthetics* (EA). These findings confirm the notion that "*what is orderly is beautiful and usable*" [3]. They imply that designers of mobile websites should focus on improving the more objective aesthetic dimension of their websites (*classical aesthetics*) in order to increase their *perceived usability* and *perceived expressive aesthetics* as well. In other words, they should emphasize simplicity (the hallmark of *classical aesthetics*) in their user interface design rather than complexity (the hallmark of *expressive aesthetics*) [13, 21], as the former is a stronger determinant of *perceived usability*. This has the potential of positively influencing the *perceived usefulness* of and the *intention to use* their websites [27].

The rest of this paper is organized as follows. Sections 2 and 3 focus on background and related work respectively. Section 4 explains the research method used. Sections 5 and 6 dwell on result and discussion respectively. Finally, Sect. 7 focuses on conclusion and future work.

2 Background

In this section, we provide a brief overview of the hedonic and utilitarian HCI design constructs and the two types of cultures we considered in our study.

2.1 HCI Design Constructs

Perceived Aesthetics. It is defined as the visual appearance and appeal of an artifact. In HCI design, it is composed of two major dimensions: *classical* and *expressive* [22].

Classical Aesthetics. *Classical aesthetics* relates to the historical and traditional notion of *aesthetics*, which is expressed by terms such as "clear", "clean", "orderly", etc. [13].

Expressive Aesthetics. *Expressive aesthetics* relates to the creativity and expressive ability of a designer. Thus, it is associated with terms such as "originality", "fascinating design", etc. [13, 25].

Perceived Usability. This is the *perceived ease of use* of a website [27], which indicates how effortless and effective a user's interaction with the website is [1].

2.2 Culture

Research has shown that culture plays an important role in the way people perceive user interface design [8, 17, 24]. Among others, one of the main categorizations of culture used in HCI studies is based on the context of communication [18, 24].

Low-Context Culture. A low-context (LC) culture is that type of culture, which has a communication style in which messages are expressed explicitly by the speaker, leaving little or nothing to be inferred from the context of communication by the receiver [10, 14]. Examples of LC cultures include Canada, United States, Germany, etc. [18].

High-Context Culture. A high-context (HC) culture is that type of culture, which has a communication style in which messages are expressed implicitly by the speaker, leaving much to be inferred from the context of communication by the receiver [10, 14]. Examples of HC cultures include Nigeria, China, Japan, Arab nations, etc. [18].

3 Related Work

Research has shown that the *perceived aesthetics* of HCI artifacts influences their *perceived usability*. Tractinsky et al. [26] were among the first researchers in the field to report this finding based on their experimental study. They attributed their finding to a socio-psychological phenomenon known as halo effect and concluded that "*what is beautiful is usable*." This notion was validated by a two-stage study they carried out using a computerized surrogate for an Automated Teller Machine (ATM) in which users reported their *aesthetics* and *usability* perceptions before and after the use of the ATM. They found that *perceived aesthetics* before the use of the ATM influenced users' *perceived usability* of the ATM after use. The study by Tractinsky et al. [26] was conducted in order to verify the findings by Kurosu and Kashimura [12], who had earlier found in their study based on an ATM interface that *perceived usability* (*apparent usability*) was influenced by *perceived aesthetics* and not the *actual usability* (*inherent usability*) of the ATM. This had made the latter authors to recommend that information technology products should be designed to be *apparently* usable as well as *inherently* usable. Further, Sonderegger and Sauer [23] carried out a study on how the *appearance* of a mobile phone affected its *perceived usability*. Using two visually manipulated versions of the phone, they found that participants using the highly appealing version rated their device as being more usable than participants using the

non-appealing version. Similarly, in separate empirical studies, Coursaris and Kripintris [5] and Oyibo and Vassileva [16] found that *perceived aesthetics* strongly impacted *perceived usability*. Finally, in their study of the impact of *color temperature* on *web aesthetics*, Coursaris et al. [3] found that *classical aesthetics* strongly influenced *expressive aesthetics*.

However, research on the influence of hedonic dimensions on *usability* is still limited [3], especially with respect to how the two main dimensions of *aesthetics* influence *usability*. Moreover, limited studies have investigated the cultural moderation of the relationships among the three HCI design constructs [25]. In the existing literature, there are barely studies which focused on countries from the African continent; neither are there comparative studies, which specifically focused on both African and Western cultures. It is this gap in the literature that we set out to fill in this paper.

4 Method

In this section, we present our research design, hypotheses, the instruments used to measure the HCI design constructs of interest, and the demographics of the participants.

4.1 Research Design

In this paper, we are interested in answering three research questions as follows:

1. Which of the dimensions of *aesthetics* (*classical aesthetics* and *expressive aesthetics*) serves as the linkage between *aesthetics* and *usability* [13]. In other words, which of the two aesthetic dimensions determines *perceived usability?*
2. How strongly does *classical aesthetics* influence *expressive aesthetics*?
3. Do these relationships depend on culture and/or the visual aesthetics and navigational characteristics of the user interface (UI)?

To answer the above research questions, we came up with four systematically manipulated web designs, as shown in Fig. 1. We regard the two UIs at the top as low-level designs and the two UIs at the bottom as high-level designs. As described in [14, 15], beginning from mobile website A, we transformed the UI to mobile website B by changing the multicolor-theme to an image-based, gray-theme design in an attempt to realize a highly minimalist design. Next, we transformed mobile website B to a monochrome (blue-theme) design to realize a cool-temperature web design. Finally, we transformed mobile website C to mobile website D by just changing the layout (a structural/navigational manipulation) from list to grid.

4.2 Research Hypotheses

In answering our research questions, we reviewed the literature to come up with the hypothesized path model shown in Fig. 2. Based on the existing empirical findings in the literature, we formulated six hypotheses on the inter-relationships among *perceived*

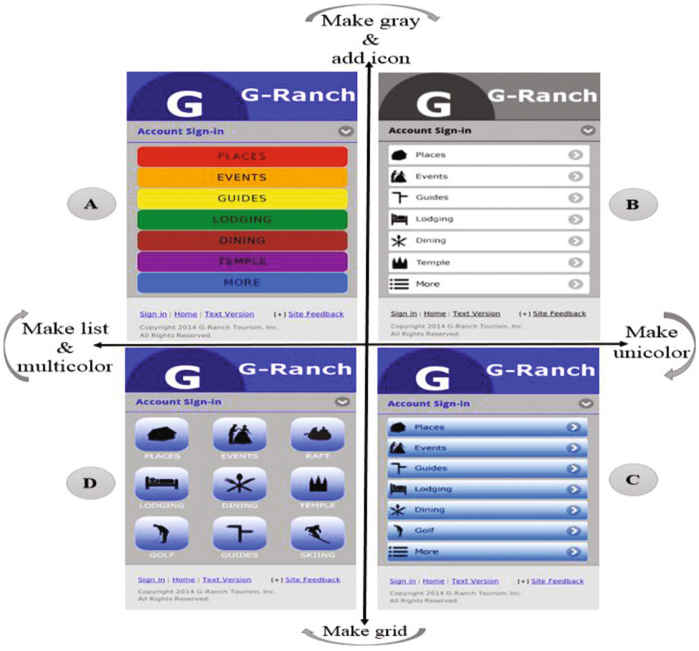

Fig. 1. Systematically designed mobile websites (Color figure online)

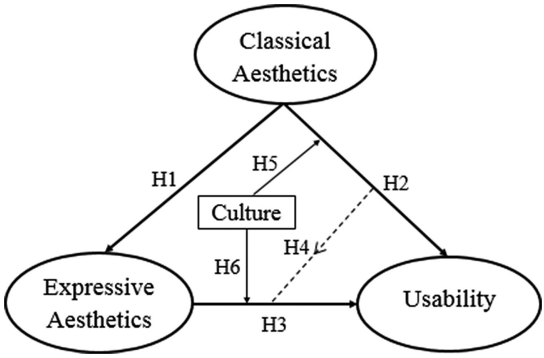

Fig. 2. Hypothesized path model

classical aesthetics, *perceived expressive aesthetics* and the *perceived usability* of a mobile websites. These relationships are represented in Fig. 2 and expressed as follows:

H1: *Classical aesthetics* will positively influence *expressive aesthetics*.
H2: *Classical aesthetics* will positively influence *perceived usability*.
H3: *Expressive aesthetics* will positively influence *perceived usability*.
H4: The influence of *classical aesthetics* on *perceived usability* is stronger than the influence of *expressive aesthetics* on *perceived usability*.

H5: The influence of *classical aesthetics* on *perceived usability* will be moderated by culture.
H6: The influence of *expressive aesthetics* on *perceived usability* will be moderated by culture.

The above hypotheses are informed by prior findings in the literature. First, H1 was based on the findings by Coursaris et al. [3] and van Schaik and Ling [21]. The first group of authors found that *classical aesthetics* influences *expressive aesthetics*, while the second group found a strong correlation between both dimensions of *aesthetics*. We decided to investigate this relationship because limited studies have done so in the mobile domain. Coursaris et al. [3] have argued that findings regarding this relationship may help extend Tractinsky et al.'s [26] notion of "*what is beautiful is usable*" to "*what is orderly is beautiful*" [3, p. 116], since *classical aesthetics* pertains to the notion of organization (i.e., orderliness) and *expressive aesthetics* pertains to the notion of creativity and harmony in the use of colors in designs (i.e., beauty). Second, H2 and H3 were informed by the work of Sánchez-Franco et al. [20], who investigated these relationships (in their case, the influence of *classical aesthetics* and *expressive aesthetics* on *perceived usefulness,* which, in TAM, is directly influenced by *perceived ease of use* [27]). While they did not find a significant relationship between *classical aesthetics* and *perceived usefulness*, they found between *expressive aesthetics* and *perceived usefulness*. Consequently, this calls for further investigation of these relationships to confirm or disprove their findings. Third, H4, which states that the impact of *classical aesthetics* on *perceived usability* will be stronger than the impact of *expressive aesthetics* on *perceived usability*, was informed by the notion that *classical aesthetics* deals with orderliness and cleanliness, which are "*closely related to many of the design rules advocated by usability experts*" (p. 269), while *expressive aesthetics* deals with the designer's creativity and originality [13]. Based on these notions and the findings by Lavie and Tractinsky [13] in the web domain, we hypothesized that *classical aesthetics*, which, conceptually, is more related to *usability* than *expressive aesthetics*, will influence *perceived usability* more than *expressive aesthetics* will influence *perceived usability*. Finally, regarding H5 and H6, we hypothesized that their corresponding relationships (see Fig. 2) will be moderated by culture based on the previous study by Oyibo and Vassileva [16], in which they found a moderation effect by culture of the relationship between *perceived aesthetics* (composed of *classical aesthetics* and *expressive aesthetics*) and *perceived usability*. Specifically, they found that the influence of *perceived aesthetics* on *perceived usability* was stronger for a high-context culture (Nigeria) than a low-context culture (Canada).

4.3 Measurement Instruments

We used existing validated instruments to measure all three HCI design constructs under investigation. To measure *classical and expressive aesthetics*, we used the respective 3-item versions of Lavie and Tractinsky's [13] *classical* and *expressive aesthetics* scale as adapted by van Schaik and Ling [21]. Similarly, to measure *perceived usability*, we used Lavie and Tractinsky's 5-item scale [13]. Each item in each

scale was measured using a 7-point Likert scale, ranging from *Strongly Disagree (1)* to *Strongly Agree (7)*. In the administration of the online survey, all of the items from the three scales with respect to each webpage were presented together in a randomized fashion to each participant in order to prevent him/her from easily knowing which construct was being measured at a given time if each construct's items were presented separately in a block.

4.4 Participants

The survey was approved by the University of Saskatchewan Research Ethics Board. Participants were recruited on the university's website, Facebook and by emails. To appreciate them for their time, they were given a chance to win one of four $50 CAD gift cards. A total of 233 participants from Canada and Nigeria took part in the study. Table 1 shows the demographics of participants. Among them were 54.5% males and 45.5% females. Age-wise, 67.8% were between the age of 18 and 24 years old, while 30.4% were above 24 years old. Education-wise, 57.9% had high school education; 24.5% had university education; and 8.2% had postgraduate education.

Table 1. Participants' demographics

N = 233	
Gender	Male (127, 54.5%); Female (106, 45.5%)
Country	Canada (87, 37.3%); Nigeria (146, 62.7%)
Age	18–24 (158, 67.8%); > 24 (71, 30.4%); Unidentified (4, 1.7%)
Education qualification	High school (135, 57.9%); Bachelor degree (57, 24.5%); Postgraduate degree (19, 8.2%); Others (22, 9.4%)
Internet experience	0–3 years (18, 7.7%); 4–6 years (42, 18.0%); 7–9 years (49, 21.0%); > = 10 years (124, 53.2%)

5 Results

In this section, we present the result of our path analysis using R's Partial Least Square Path Modeling (PLS-PM) package [19], starting with the assessment of the measurement models.

5.1 Measurement Model Evaluation

In the measurement model evaluation, we assessed indicator reliability, internal consistency reliability, convergent validity and discriminant validity [9, 19]. *Indicator Reliability:* With respect to each construct measured using multiple items, all the indicators in the measurement models had an outer loading greater than 0.7 [9]. Thus, the reliability criterion was met, as the communality value for all indicators were greater than 0.5. *Internal Consistency Reliability:* Internal consistency reliability was evaluated using the composite reliability criterion, DG.rho (ρ). The ρ values for the

multiple-item constructs were greater than 0.7 [9]. *Convergent Validity:* The Average Variance Extracted (AVE) was used to evaluate convergent validity. The AVE for the constructs in the model was greater than 0.5 as recommended [9]. *Discriminant Validity:* The crossloading of each construct was also evaluated. No indicator loaded higher on any other construct than the one it was meant to measure.

5.2 Data-Driven Path Model

Figures 3 and 4 show the data-driven model at the global and subgroup levels, respectively. The global model was meant to serve as a control for confirming findings at the subgroup level [6]. At the global level, the goodness of fit (GOF) for the model ranges from medium (67% for webpages B and C) to high 75% (for webpage D), indicating that the model fits the data well to a high degree [19]. Similarly, the coefficient of determination (R^2) of *perceived usability* ranges from moderate (49% for webpage B) to high (70% for webpage D), based on the PLS-PM guideline, where $R^2 < 30$ is low, $0.30 < R^2 < 0.50$ is moderate and $R^2 > 0.60$ is high [19]. This indicates a large amount of the variance of *perceived usability* is accounted for by *classical aesthetics* and *expressive aesthetics*, with the former having a greater effect size and the latter having a little or no effect size. In the same vein, *classical aesthetics* accounts for

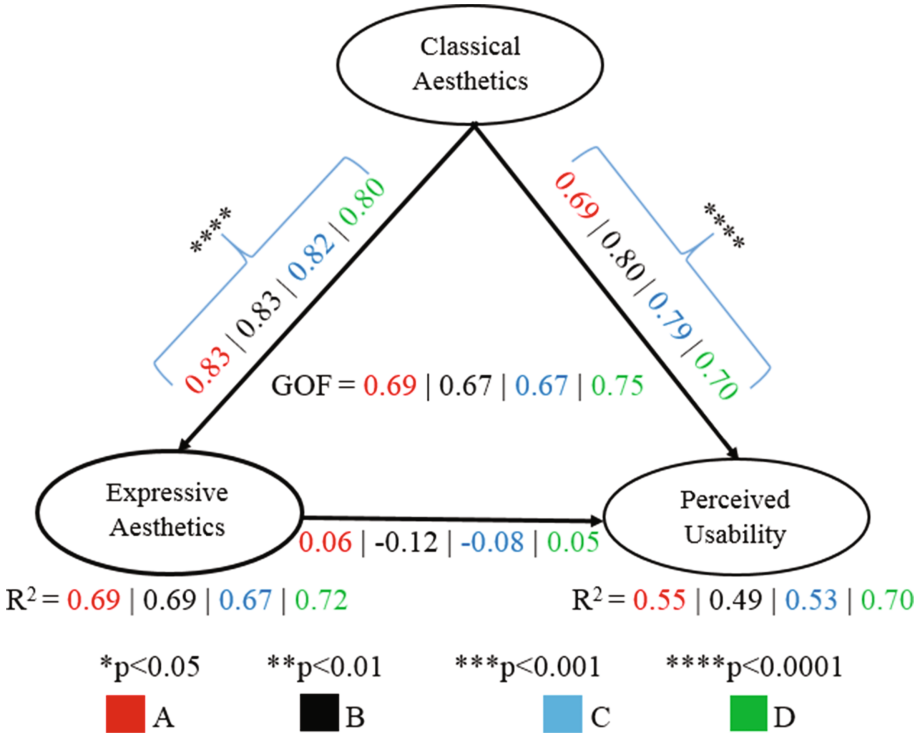

Fig. 3. Data-driven global model

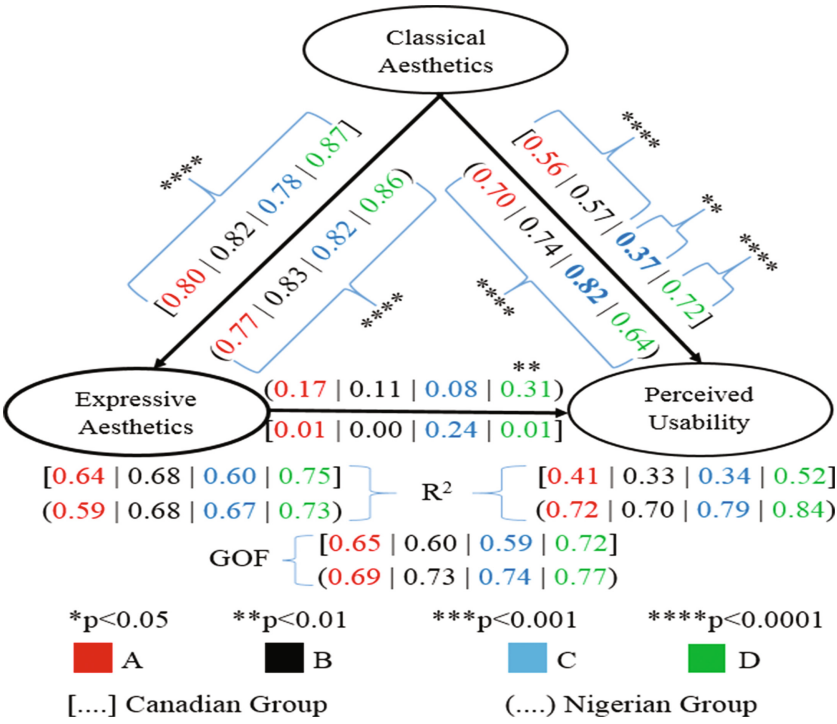

Fig. 4. Data-driven subgroup models (Color figure online)

most of the variance of *expressive aesthetics*, ranging from 69% (for webpages A and B) to 72% (for webpage D). At the subgroup level, to a large extent, we see a replication of the significant path coefficients at the global level, except for path EA→PU, where the path coefficient ($\beta = 0.31$, $p < 0.01$) for mobile webpage D is significant for the Nigerian group (NG), but not in the global and Canadian group (CG) models. Overall, the R^2 of *perceived usability* for all four webpages are higher for the NG (0.72 | 0.70 | 0.79 | 0.84) than for the CG (0.41 | 0.33 | 0.34 | 0.52) by about 30%, indicating the predictive accuracy of the models are higher for a high-context culture than a low-context culture.

5.3 Effect Sizes of Direct Influences

In the effect-size analysis [9] (see Table 2), we found that *expressive aesthetics* (EA) has a significant impact on *perceived usability* (PU) in the absence of *classical aesthetics* in the model. However, once *classical aesthetics* (CA) is controlled for in the model, the impact of *expressive aesthetics* becomes virtually insignificant. For example, for webpages A, B, C and D in the global model, without CA in the model, the path coefficients for EA→PU are (0.63 | 0.54 | 0.57 | 0.73, $p < 0.001$). However, on including CA in the model the path coefficients (0.06 | −0.12 | −0.08 | 0.05, p = n.s)

Table 2. Effect sizes of influence of classical and expressive aesthetics on usability

Global model						
Webpage	CA Included		CA Excluded		Effect size	Remark on effect size
	EA→PU	R^2	EA→PU	R^2	CA→PU	
A	0.06	0.55	0.63***	0.40	0.33	Medium
B	−0.12	0.49	0.54***	0.29	0.39	Medium
C	−0.08	0.53	0.57***	0.32	0.45	Medium
D	0.05	0.70	0.73***	0.53	0.57	Medium
	EA Included		EA Excluded			
	CA→PU	R^2	CA→PU	R^2	EA→PU	
A	0.69***	0.55	0.74***	0.55	0.00	No
B	0.80***	0.49	0.72***	0.51	−0.04	Weak (Neg)
C	0.79***	0.53	0.73***	0.54	−0.02	Weak (Neg)
D	0.70***	0.70	0.83***	0.70	0.00	No
Canadian subgroup model						
Webpage	CA Included		CA Excluded		Effect size	Remark on effect size
	EA→PU	R^2	EA→PU	R^2	CA→PU	
A	0.01	0.41	0.55***	0.30	0.19	Medium
B	0.00	0.33	0.48***	0.23	0.15	Medium
C	0.24	0.34	0.53***	0.28	0.09	Weak
D	0.01	0.52	0.63***	0.40	0.25	Medium
	EA Included		EA Excluded			
	CA→PU	R^2	CA→PU	R^2	EA→PU	
A	0.56***	0.41	0.65***	0.42	−0.02	Weak (Neg)
B	0.57***	0.33	0.60***	0.36	−0.04	Weak (Neg)
C	0.37**	0.34	0.58***	0.33	0.02	Weak
D	0.72***	0.52	0.73***	0.53	−0.04	Weak (Neg)
Nigerian subgroup model						
Webpage	CA Included		CA Excluded		Effect size	Remark on effect size
	EA→PU	R^2	EA→PU	R^2	CA→PU	
A	0.17	0.72	0.71***	0.51	0.75	Large
B	0.11	0.70	0.72***	0.52	0.60	Large
C	0.08	0.79	0.76***	0.58	1.00	Large
D	0.31**	0.84	0.86***	0.74	0.63	Large
	EA Included		EA Excluded			
	CA→PU	R^2	CA→PU	R^2	EA→PU	
A	0.70***	0.72	0.84***	0.70	0.07	Weak
B	0.74***	0.70	0.83***	0.69	0.03	Weak
C	0.82***	0.79	0.89***	0.79	0.00	No
D	0.64***	0.84	0.90***	0.82	0.13	Weak

become insignificant. Further, we see in Table 2 that the effect sizes of CA on PU with respect to all four webpages are larger for the NG (0.75 | 0.60 | 1.00 | 0.63) than they are for the CG (0.19 | 0.15 | 0.09 | 0.25). According to Cohen's guideline [2], effect sizes of magnitudes 0.02, 0.15 and 0.35 represent small, medium and large effect sizes respectively. Thus, the effect sizes with respect to CA→PU for the NG are all large, while those for the CG are mostly medium. This suggests that the magnitude of strength of the relationship between CA and PU is stronger for the NG than for the CG. On the hand, we find that the effect sizes of EA on PU are either weak, non-existent or even negative, as shown in the global and CG models. The negative effect sizes with respect to EA→PU suggest that the models with EA excluded are better than the ones with EA included. This is evident in the R^2 values of both models in contention. For example, in the global model with respect to webpage B, the R^2 for PU is 0.49 when EA is included and 0.51 when EA is excluded. Similarly, in the CG subgroup model with respect to webpage B, the R^2 for PU is 0.33 when EA is included and 0.36 when EA is excluded. This indicates the latter models with EA excluded are better in terms of predictive accuracy, especially if we have to compute the adjusted coefficient of determination, R^2_{adj}, a metric for selecting models and which penalizes a model with more exogenous constructs involved in the prediction of the endogenous construct [9].

5.4 Verification of Hypotheses

We tabulated the results from the verification of all six hypotheses in Table 3. As shown in Table 3, H1, H2 and H4 are fully supported, but H3, H5 and H6 are not. However, H3 and H5 are partially validated. This is represented in Table 3 as "Part". At the global level (see Fig. 3), regarding H1 and H2 with respect to webpages A, B, C and D, the path coefficients for CA→EA are (0.83 | 0.83 | 0.82 | 0.80, $p < 0.0001$) and those for CA→PU are (0.69 | 0.83 | 0.79 | 0.70, $p < 0.0001$). These path coefficients are high, indicating a strong validation of H1 and H2 at the global level. At the subgroup level (see Fig. 4), the respective path coefficients for the CG for all webpages are (0.80 | 0.82 | 0.78 | 0.87, $p < 0.0001$) for CA→EA and (0.56 | 0.57 | 0.37 | 0.72, $p < 0.01$) for CA→PU. Similarly, the respective path coefficients for the NG for all webpages are (0.77 | 0.83 | 0.82 | 0.86, $p < 0.0001$) for path CA→EA and (0.70 | 0.74 | 0.82 | 0.64, $p < 0.0001$) for path CA→PU. These path coefficients at the subgroup level are highly significant as well, for the most part. Therefore, our H1 (*classical aesthetics will positively influence expressive aesthetics*) and H2 (c*lassical aesthetics will positively influence perceived usability*) are confirmed at the global and subgroup levels.

However, our H3 (*expressive aesthetics will positively influence perceived usability*) is not validated at the global level though partially validated at the subgroup level. At the global level, the path coefficients for EA→PU, ranging from −0.12 to 0.06, are insignificant with respect to all four webpages. Similarly, at the subgroup level, the path coefficients for EA→PU, ranging from 0.00 to 0.24 are insignificant with respect to webpage A, B and C. However, the path coefficient ($\beta = 0.31$, $p < 0.01$) for EA→PU with respect to webpage D (for the NG), is significant. Nevertheless, the number of significant paths (one out of twelve cases) is not sufficient for us to conclude that H3 is validated. As such, we conclude that our H3 is partially supported.

Table 3. Results of verification of hypotheses

No.	Hypothesis	Path	Supported?		
			Global	CG	NG
H1	*Classical aesthetics* will positively influence *expressive aesthetics*	CA→EA	Yes	Yes	Yes
H2	*Classical aesthetics* will positively influence *perceived usability*	CA→PU	Yes	Yes	Yes
H3	*Expressive aesthetics* will positively influence *perceived usability*	EA→PU	No	No	Part
H4	The influence of *classical aesthetics* on *perceived usability* is stronger than the influence of *expressive aesthetics* on *perceived usability*	CA→PU > EA→PU	Yes	Yes	Yes
H5	The influence of *classical aesthetics* on *perceived usability* will be moderated by culture	CA→PU (culture-moderated)	Part		
H6	The influence of *expressive aesthetics* on *perceived usability* will be moderated by culture	EA→PU (culture-moderated)	No		

Further, we see our H4 (*the influence of classical aesthetics on perceived usability is stronger than the influence of expressive aesthetics on perceived usability*) is validated at both levels of path modeling. At the global level, the path coefficients (0.69 | 0.80 | 0.79 | 0.70, $p < 0.0001$) corresponding to H2 (CA→PU) are greater than the respective path coefficients (0.06 | −0.12 | −0.08 | 0.05, p = n.s) corresponding to H3 EA→PU. H4 is also validated at the subgroup levels: (1) for the CG, the path coefficients (0.56 | 0.57 | 0.37 | 0.72, $p < 0.01$) for CA→PU are greater than the respective path coefficients (0.01 | 0.00 | 0.24 | 0.01, p = n.s) for EA→PU; and (2) for the NG, the path coefficients (0.70 | 0.74 | 0.82 | 0.64, $p < 0.0001$) for CA→PU are greater than the respective path coefficients (0.17, p = n.s | 0.11, p = n.s | 0.08, p = n.s | 0.31, $p < 0.01$) for EA→PU. Therefore, our H4 is strongly supported.

The validation of these three hypotheses (H1, H2 and H4) at the global and subgroup levels is an indication that, irrespective of culture, the respective hypotheses are valid.

Finally, our H5 and H6 on moderation effect by culture are only partially validated, i.e., for webpage C, where culture moderates the path CA→PU, with the NG (a high-context culture) having a higher effect ($\beta = 0.82$, $p < 0.0001$) than the CG (a low-context culture), which has the effect ($\beta = 0.37$, $p < 0.01$).

6 Discussion

We have presented a path model for predicting the *perceived usability* (a utilitarian construct) of a mobile website using the two conceptual and operationalized dimensions of *perceived aesthetics* (a hedonic construct). The different data-fitted models have a moderate to high coefficient of determination (ranging from 30% to 80%), which represents the amount of variance *of perceived usability* accounted for with respect to each mobile webpage. More importantly, based on the four versions of the hypothetical mobile webpage with different levels of aesthetic treatment (low and high), we show that, in the mobile web domain, irrespective of the level of aesthetic treatment and culture, *classical aesthetics* is a stronger predictor of *perceived usability* than *expressive aesthetics*. This indicates, from the conceptualization and operationalization of the two dimensions of *aesthetics* that it is the simplicity and orderliness of a website design—and not its complexity and creativity—that inform their *perceived usability*. In fact, as the models reveal, the perception of the simplicity and orderliness of a website design (*classical aesthetics*), in addition to impacting its *perceived usability*, can impact its perceived creativity and originality (*expressive aesthetics*) as well. Thus, we can conclude, based on these findings represented in our models, that "*what is classical is expressively beautiful and usable*."

Further, we show that the relationship between *classical aesthetics* and *perceived usability* is likely to be stronger for a high-context culture (Nigeria) than a low-context culture (Canada), as shown in Fig. 5, where, except for webpage D, the path coefficients for this relationship are relatively higher for the Nigerian group than for the Canadian group. This is supported by the effect sizes with respect to all four webpages being larger for the Nigerian group than those for the Canadian group, which range from weak to medium effect sizes. Specifically, for webpage C, we found a significant difference between this relationship for the Nigerian group and that for the Canadian group. The corresponding effect size of this relationship is large for the Nigerian group but weak for the Canadian group. These two findings—(1) the relationship between *classical aesthetics* and *perceived usability* being stronger for the Nigerian group than

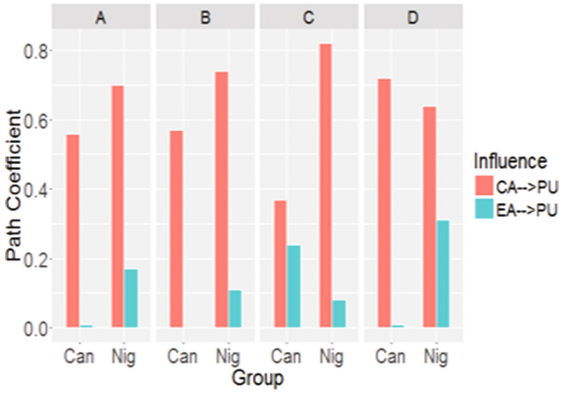

Fig. 5. Visualization of usability-related path coefficients (Color figure online)

it is for the Canadian group with respect to webpage C; and (2) the effect sizes for the Nigerian group being larger than those for the Canadian group with respect to all webpages—indicate that the *classical aesthetics-perceived usability* relationship may be stronger for a high-context culture than a low-context culture. However, this finding requires further research, especially with a different population sample, in order to generalize across high-context and low-context cultures as a whole.

Moreover, there seems to be an interesting observation worth noting regarding webpage C and webpage D (see Fig. 5). For webpage C, relative to the other webpages, the impact of *classical aesthetics* on *perceived usability* (CA→PU) decreases for the Canadian group, while the impact of *expressive aesthetics* on *perceived usability* (EA→PU) increases. On the other hand, with respect to the same webpage C, the impact of *classical aesthetics* on *perceived usability* (CA→PU) increases for the NG, while the impact of *expressive aesthetics* on *perceived usability* (EA→PU) decreases. The reverse is virtually the case for both groups when it comes to webpage D. In other words, *expressive aesthetics* seems to play a more prominent role with respect to webpages C and D (high-level designs) than webpages A and B (low-level designs). As shown in Figs. 4 and 5, with respect to webpage C (list-based, blue-theme webpage) for the Canadian group, *classical aesthetics* and *expressive aesthetics* are relevant in predicting *perceived usability* though the latter impact (EA→PU) did not reach statistical significance, perhaps due to the small sample size of 87 for the Canadian group. However, EA→PU relationship is almost significant (given the p-value = 0.07). This indicates both the perception of *classical aesthetics* and perception of *expressive aesthetics* were important for the Canadian group in predicting the *perceived usability* of webpage C, but *expressive aesthetics* was not important in predicting the *perceived usability* of webpage C for the Nigerian group. On the other hand, both perception of *classical aesthetics* and perception of *expressive aesthetics* were important in predicting *perceived usability* with respect to webpage D (grid-based, blue-theme webpage) for the Nigerian group, but *expressive aesthetics* was not important in predicting the *perceived usability* of webpage D for the Canadian group. This suggests that the impact of *expressive aesthetics* on *usability* (EA→PU) may depend on culture and the level of aesthetic treatment of the web design, as seen with webpages C and D, both of which are high-level designs but with different layouts. The *perceived expressive aesthetics* of webpage D seems to resonate more with the Nigerian group ($\beta = 0.31$, $p < 0.01$), while that of webpage C seems to resonate more with the Canadian group ($\beta = 0.31$, t-value = 1.84). One possible explanation why *expressive aesthetics* impacts *perceived usability* more with respect to the high-level designs (webpage C for the Canadian group and webpage D for the Nigerian group) at the subgroup level is that the blue theme used in both webpages seem to resonate better with participants (perhaps due to its popularity in web design, e.g., banking and social networking sites such as Facebook and Twitter) than the multicolor and grey themes used in webpages A and B, which seem to be out of harmony and emotionless, respectively. For example, in our prior data analysis [14], webpages C and D were ranked most credible than webpages A and B. Besides, the use of blue theme seems to align with the concept of *expressive aesthetics*, which entails the expression of emotions and the harmony of colors [13]. Use of cool colors in web design, such as blue (a cool color), has been linked to the creation of positive impressions, which may help in building credibility and trust in websites [4].

6.1 Comparison Between Previous and Current Study's Models

As shown in Fig. 6, we compare the coefficients of determination of *perceived usability* in the current model (see Fig. 4), where *classical aesthetics* and *expressive aesthetics* are considered as separate predictors of *perceived usability*, with the corresponding coefficients of determination in our previous model [16], where *aesthetics* was considered as a higher-order construct composed of *classical* and *expressive aesthetics* in order to know how the two models are similar or differ. These two models are represented as "composite" and "components" respectively in Fig. 6. The aim of our comparison is to uncover how the coefficient of determination metric of *perceived usability* changes when its predictor *perceived aesthetics* is considered as a composite high-order construct and two separate lower-order dimensional constructs. As shown in the plot, the respective coefficients of determination in the composite and components models are virtually equal, indicating the latter model is as good as the former model [16] in predicting *perceived usability*, if not better given the relatively higher coefficients of determination in the current model, especially for the Nigerian group. The lesson learned from the comparison of these models is that: (1) predicting *perceived usability*, using *perceived aesthetics* as a composite or its two separate dimensions as its antecedents, is likely to give the same result (i.e., coefficient of determination); (2) *classical aesthetics* is the stronger predictor of *perceived usability*; and (3) *expressive aesthetics* is barely a predictor of *perceived usability* when *classical aesthetics* is controlled for in the model. These findings were unknown in the previous model [16], where *perceived aesthetics* was considered as a composite higher-order construct.

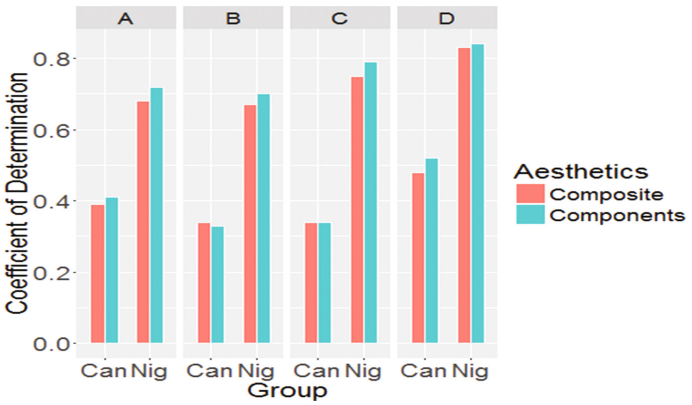

Fig. 6. Visualization of usability coefficient of determination

6.2 Summary and Implication of Findings

In summary, with respect to mobile web design, we conclude as follows. First, it is *perceived classical aesthetics* that predominantly determines *perceived usability*, irrespective of the visual and navigational design of the mobile website. This finding replicates that of Lavie and Tractinsky [13], who found stronger correlation between

classical aesthetics and *perceived usability* than between *expressive aesthetics* and *perceived usability* in the web domain. It implies that designers of mobile websites should work towards creating sites that are more classically aesthetic (simple) than expressively aesthetic (complex) [13], as the former is what more or less determines *perceived usability*. This may be instrumental to the use of mobile websites given the importance attached to *usability* due to the relatively small screen size of mobile devices. Second, the effect size of *classical aesthetics* on *perceived usability* is higher for a high-context culture (Nigeria) than a low-context culture (Canada). This implies that a high-context culture is much more likely to judge the *usability* of a mobile website based on its *classical aesthetics* than a low-context culture.

6.3 Contributions

Our contribution to the body of knowledge is that we replicated in the mobile domain prior findings in the web domain by Levy and Tractinsky [13] and Coursaris et al. [3] using two different cultures and four different web designs. They include: (1) *classical aesthetics* is stronger than *expressive aesthetics* in predicting *perceived usability*; and (2) *classical aesthetics* strongly influences *expressive aesthetics*. In addition, we showed that differences exist between both cultures: (1) the model for the high-context culture has a higher predictive accuracy than the model for the low-context culture; and (2) the effect size of the relationship between *classical aesthetics* and *perceived usability* is higher for the high-context culture than the low-context culture. Finally, to the best of our knowledge, this is one of the first studies which have investigated the subject of this paper across a low-context and a high-context culture.

6.4 Limitation

The limitation of our study is that our findings are based on perception and not the actual usage of the respective mobile webpages. This may threaten the generalizability of our findings to the actual usage context. Another limitation is that we only considered one country in each type of the two cultures, which may also threaten the generalizability of our findings regarding low-context and high-context cultures.

7 Conclusion and Future Work

Using path analysis, with data on four different mobile web designs collected for two different types of cultures, we presented a model showing that *perceived classical aesthetics* is stronger than *perceived expressive aesthetics* in predicting *perceived usability* of mobile websites, with the effect size being larger for the high-context culture than the low-context culture. Our models account for 30% to 80% of the variance of *perceived usability*. We also showed that the *perceived classical aesthetics* of mobile websites strongly impacts the *perceived expressive aesthetics* for both cultures. The implication of our findings is that designers of mobile websites should focus

more on improving the objective aesthetic dimension (*classical aesthetic*) of their websites, which is characterized by simplicity and orderliness, with a view to increasing their *perceived usability*. This has the potential of impacting users' *intention to use* such mobile websites. In future work, we look forward to carrying out qualitative analysis to get a deeper understanding of the relationships among the three constructs of interest and investigating other low-context and high-context cultures in order to generalize our findings.

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