

# Aesthetics and Apparent Usability: Empirically Assessing Cultural and Methodological Issues

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*" it requires a somewhat mystical theory of aesthetics to find any necessary connection between beauty and function." (Herbert Read, Art and Industry, p. 611.*

## ABSTRACT

Three experiments were conducted to validate and replicate, in a different cultural setting, the results of a study by Kurosu and Kashimura [12] concerning the relationships between users' perceptions of interface aesthetics and usability. The results support the basic findings by Kurosu and Kashimura. Very high correlations were found between perceived aesthetics of the interface and *a priori* perceived ease of use of the system. Differences of magnitude between correlations obtained in Japan and in Israel suggest the existence of cross-cultural differences, but these were not in the hypothesized direction.

## Keywords

Aesthetics, apparent usability, system acceptability, cross-cultural HCI, human-computer interface

## INTRODUCTION

The quest for usable computer technology is one of the major goals in the field of Human-Computer Interaction (HCI), and critiquing the poor usability of systems designed for human use has become the *hon ton* in the field (e.g. [14]). Shackel [27] and Nielsen [21] place the concept of usability within the framework of system acceptability: Together with other system attributes, such as cost, utility (functionality) and likeability, system usability determines whether people will accept the use (or purchase) of a computerized system. With issues of cost determined by technological and economic factors, and utility predominated by specific tasks, HCI researchers have concentrated mainly on the study of usability. Here, knowledge of human cognitive and

perceptual capabilities and limitations has provided fertile ground for formulating principles (e.g., [22]) and guidelines (e.g., [28,21]) of usable systems. Nielsen [21] defines the *usability* of a computer system in terms of five attributes: Learnability, efficiency, memorability, errors, and satisfaction. In general, the evaluation of system usability requires that these attributes be measured during or after people have actually used the system. Thus, while designers might rely on principles and guidelines to design usable systems, the use of certain inspection methods, if not extensive testing, is required to establish a certain degree of *usability*. On the other hand, evaluating other determinants of system acceptability may not require such a lengthy process. For example, system cost or likeability can be evaluated relatively simply and quickly. Thus, much effort might be invested by HCI designers in their attempts to evaluate and improve usability whereas, at the same time, other acceptability attributes may have an overriding effect on purchase or usage decisions. Whether these attributes are not considered to be an integral part of the HCI field, or because of an implicit assumption of orthogonality between these attributes and usability, the relationships' between system usability and other determinants of system acceptability have not received extensive treatment in the HCI literature. This study calls attention to these relationships and to their potential contribution to our evaluation of system acceptability and to our understanding of its antecedents.

## AESTHETICS AND USABILITY

The role of aesthetics' in human affairs has been widely documented (e.g., [17]). Conventional wisdom relates it to our appreciation of, and attitudes towards computer systems as well. However, aesthetics may not always coincide with usability. In fact, the opposite might occur. In one of HCI's most influential books, "The Psychology of Everyday Things", Norman vividly ridicules the

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<sup>1</sup> In the context of this study, we adopt a narrow definition of aesthetics in which aesthetics can be seen as a synonym for visual beauty.

tendency of designers to neglect usability in favor of aesthetics [21] (pp. 151-155). Similarly, others (e.g. [7, 18]), while acknowledging the role of aesthetics in HCI, warn against a tendency among designers to emphasize the aesthetic elements of the user interface, because these might degrade usability. The contribution of aesthetics to HCI, they argue, should be measured in terms of facilitating information processing, not in terms of engaging the user in a pleasing experience. Perhaps, because aesthetics mainly reflect on the latter, HCI literature in general, and on usability in particular, mostly seem to neglect the aesthetics issue completely. For example, the indices of 4 prominent HCI textbooks and reading collections [1, 4, 24, 28] do not contain a single entry for “aesthetics” (or synonyms and related concepts such as “appearance”, “attractiveness”, “beauty” or “form”). Thus, it would appear that mainstream HCI (but, of course, see Laurel [15,16] for a notable exception) either belittles the importance of aesthetics or ignores it altogether.

A recent study by Kurosu and Kashimura [12] hints that interface aesthetics may play a greater role in people's attitudes towards computerized systems than we might be willing to admit. In their study, Kurosu and Kashimura (KK) explored the relationships between *a priori* perceptions of the ease of use of an automatic teller machine (ATM)—which they termed “apparent usability”—and other variables. These included factors believed by HCI professionals to enhance usability (termed “inherent usability”), and the appearance (beauty) of the interface. Surprisingly, high relationships were found between the interface judgments of aesthetics and apparent usability ( $r = 0.59$ ). The correlations between the apparent usability and inherent usability factors were mostly negligible, with the exception of one variable (familiarity with the numeric keypad). It can be argued that KK found close relationships between aesthetics and perceived usability *before* the actual use, whereas usability should actually be measured during or after system use. While this argument is valid, it should be noted that first impressions often influence attitude formation to a large extent (e.g., [3]). There is no reason to **assume** that this process of attitude formation does not pertain to the HCI domain. In fact, in a study of information systems use, researchers found that “if computers were perceived *initially* as difficult to use, users were more likely to express dissatisfaction with the interface of the system *after* four months of use.” [10] (p. 752, italics added). Thus, it is possible that among the various factors that affect system usability in particular and system acceptability in general, interface aesthetics play a major role. Aesthetics affect people's perceptions of apparent usability—which, in turn, may **influence** longer term attitudes towards the system.

## PURPOSE OF THE STUDY

The main motivation for this study is twofold. First, Kurosu and Kashimura's findings are somewhat unexpected. If these results are robust, then the importance of aesthetics in HCI should rise considerably, given the relationships between interface aesthetics, initial perception of usability, and later attitudes towards computers. However, KK's study was not void of a potential method bias that might have shifted the results in favor of stronger relations between apparent usability and aesthetics. Some modifications to their design are needed to assess the robustness of their findings.

Second, living in a culture that does not seem to value aesthetics as much as do the Japanese, the author of this study was particularly surprised by the high correlations between apparent usability and aesthetics. Clearly, aesthetic perceptions are culturally dependent [6,17]. Thus, one can reasonably expect the relationships between aesthetics and apparent usability to vary across cultures. For example, whereas Japanese culture is known for its aesthetic tradition (e.g., [6]), Israeli culture is probably better known for its action orientation [8,11]. Unfortunately, there is no scientific literature that assesses Israeli aestheticism, so mere intuition and shared feelings among Israeli colleagues were used in proposing that: *Japan and Israel potentially represent two different attitudes towards the importance of aesthetics in computerized systems and its relationships to usability and overall acceptability.*

## METHODOLOGY

Three experiments were designed and conducted in Israel to test the robustness of Kurosu and Kashimura's findings to cultural and methodological bias. Experiment 1 tested the cross-cultural robustness of KK's findings. Experiment 2 tested for possible response dependency bias in KK's experimental procedure, and Experiment 3 tested for potential medium bias. The unique aspects of each experiment and its main results are described in the next section.

### Study Materials

The original study materials (26 ATM layouts in Japanese) were provided to the author by Kurosu and Kashimura. The ATM layouts were solicited by KK from a group of 26 people: 9 GUI designers, 6 industrial engineers, 8 engineers and 3 secretaries. All layouts included the same components and were **differed** only by how these components were arranged [12]. Where necessary, the materials were translated into Hebrew and the 26 layouts were replicated. A few problems of user interface translatability were encountered at this stage. Trade-offs had sometimes to be made between ensuring the natural look of the interface to Israeli eyes on one hand, and totally preserving the Japanese original version

on the other hand. In most cases, the former approach was preferred. For example: (a) Several controls in the Japanese interface are represented as one character. In Hebrew they require a whole word.

(b) The Japanese interface included an image of a lady who is presumed to bow repeatedly to indicate that the system is processing. This concept was totally foreign to Israelis and potentially would have looked odd. Therefore, the image was replaced with an image of an hourglass which is a more familiar representation of an active system in Israel.

(c) In Japan, some actions are represented by a symbol that can't be translated directly into Hebrew. For example, the currency (Yen) symbol in the Japanese interface (one character) denotes an operation for which Israeli ATMs use (the Hebrew word for) "confirmation".

Thus, it was translated to the Hebrew equivalent of "confirmation" rather than to the Israeli currency symbol.

(d) The Japanese material was produced using Claris Works for the Mac. To use the original Japanese software one had to use a Kanji-aware Mac operating system. These are such rare birds in Israel, that different software was eventually used on a different platform (Microsoft's Visual Basic).

The results of the translation process can be seen in Figures 1 and 2, which show two examples of original Japanese layouts and their Israeli counterparts. Figure 1 presents a layout that was rated high on apparent usability and aesthetics both in Japan and in Israel. Figure 2 presents a low rating layout. (Unfortunately, for technical reasons the reproduction of the Japanese layouts in this paper is of lower quality.)

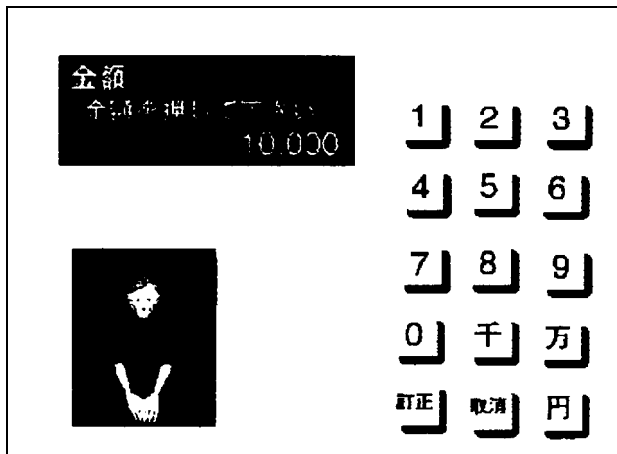


Figure 1 (a). An original Japanese interface, rated high on apparent usability and aesthetics.



Figure 1 (b). The equivalent Israeli interface, rated high on apparent usability and aesthetics.

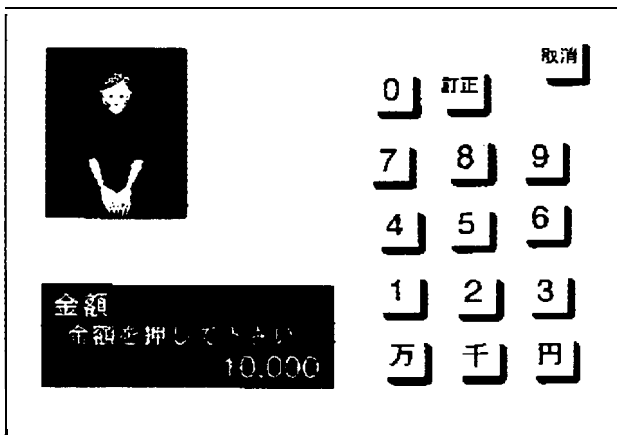


Figure 2(a). An original Japanese interface, rated low on apparent usability and aesthetics.

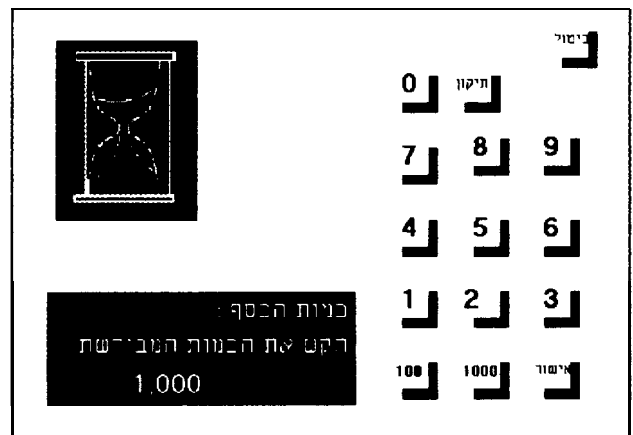


Figure 2(b). The equivalent Israeli interface, rated low on apparent usability and aesthetics.

**Variables**

In this study, seven independent, objective variables, which KK considered to be the determinants of *inherent usability* of the ATM layout were used. These variables reflect design strategies that were actually used by designers of the ATM interfaces to **affect** the cognitive and the operational efficiency of user interaction with the ATM. These variables included: (1) location of the main display (DISTANCE), (2) type of numeric keypad (KEYPAD), (3) grouping of keys according to their functions (GROUPING), (4) sequence of the special numeric keys (SEQUENCE 1), (5) location of the numeric keypad (HAND-DOMIN), (6) location of the “Confirm” key (SEQUENCE 2), (7) location of the “Cancel” key (SAFETY). A more detailed description of the variables can be found in [12]. Two dependent variables, *apparent usability* and *aesthetics*, were operationalized by asking participants to rate each design on two 1-10 scales: How easy it is to use (apparent usability), and how **beautiful** it is (aesthetics).

**THE EXPERIMENTS**

**Experiment 1: Replicating KK's study in Israel**

**Experiment 1** was designed to test the robustness of KK's results to cultural variation. Participants were 104 first-year engineering students in an Israeli University. The procedure used was identical to the one used by [12]: The twenty-six design layouts were displayed in a large classroom, using an overhead screen projector. Each layout was displayed for about 20 seconds. During that time, participants rated each **layout** on a 1 to 10 scale regarding how usable it appeared to be, and how beautiful it was.

*Results*

Participant ratings were averaged to form an apparent usability and an aesthetics score for each of the 26 designs. Mean scores for all 26 designs were similar for this and KK's study ( 5.9 vs. 6.0 for aesthetics and 5.4 vs. 5.8 for apparent usability in Israel and Japan, respectively). Scores' variability was higher in Israel than in Japan. Aesthetics scores ranged between 3.5 and 8.5 in Israel, compared to a range between 5.2 and 6.8 in Japan. Similarly, apparent usability scores for the 26 designs in Israel ranged between 2.7 and 8.5, compared to 4.4 to 6.5 in Japan. Relationships with apparent usability using the coefficient of correlation for the interval scales and the coefficient of contingency for the categorical variables are presented in Table 1, alongside the corresponding correlations from KK. In general, the relationships resemble those obtained by KK. However, the magnitude of correlation between aesthetics and apparent usability (0.921) was notably higher in this experiment. A test for differences between correlations

[9] found a significant difference between this correlation and the one obtained by KK ( $Z = 3.09, p = 0.001$ ). This suggests that, even more than their Japanese counterparts, Israelis perceived ease of use and design aesthetics to be closely related. These results are quite surprising, given the expectation that Israeli students would be less sensitive to the aesthetic aspects of the interface.

Variable	Correlations with Apparent Usability			
	KK	Exp. 1	Exp. 2	Exp. 3
AESTHETICS	<b>.589</b>	<b>.921</b>	<b>.832</b>	<b>.920</b>
DISTANCE	<b>.000</b>	.001	-.042	-.129
KEYPAD TYPE'	<b>.730</b>	.671	.751	.760
GROUPING	<b>.075</b>	<b>-.462</b>	<b>-.529</b>	<b>-.667</b>
SEQUENCE 1 <sup>#</sup>	<b>.113</b>	.352	.197	.397
HAND-DOMIN	<b>-.127</b>	<b>-.002</b>	-.125	-.203
SEQUENCE 2	<b>-.306</b>	.233	.137	.153
SAFETY	<b>.137</b>	<b>-.019</b>	<b>-.006</b>	<b>-.061</b>

**Table 1.** Correlations (bold:  $p < .01$ ) and coefficients of contingency (<sup>#</sup>) of aesthetics and seven inherent usability variables with apparent usability for the experiment in Japan (KK) and for the three experiments in Israel.

Among determinants of inherent usability, **only** keypad type and the number of grouped elements were correlated with apparent usability. Table 2 presents a contingency table in which 4 equal interval categories are used to rank the 26 designs according to their apparent usability rating. Despite the similarity in magnitude of the coefficient of contingency between Israeli and Japanese participants, a closer look at the contingency table reveals that, while the Japanese associated better usability with the horizontal keypad layout, Israelis related it to the telephone keypad. In addition, significant correlations were found in this experiment between apparent usability and the number of grouping elements in the ATM design. Higher apparent usability was associated with less groups, **defying** conventional advice in the usability literature, which calls for the separation of functionally unrelated controls (e.g., [18]).

**Experiment 2: Testing for potential response dependency**

As noted above, in both KK's study and Experiment 1, 26 different designs of an ATM interface were displayed using an overhead projector. Participants were asked to rate each design on two consecutive 1-10 scales before

advancing to the next design. Given this procedure, it is possible that the strong correlation between apparent usability and aesthetics is an artifact of a potential dependency between the responses to these questions. In Experiment 2, the procedure was modified to overcome this potential problem. The 26 designs were projected in two separated rounds. The order of presentation of the designs was determined randomly for each round. A different group of eighty-one first-year engineering students participated in this study. The students were assigned randomly to one of two conditions. In one condition, participants evaluated the design aesthetics for all 26 designs in the first round, and the apparent usability for the 26 designs in the second round. In the other condition, the order of evaluation was reversed. Because only one evaluation per overhead was needed, presentation time was cut to about 15 seconds per overhead.

### Results

Correlations and contingency coefficients are presented in Table 1. The results resemble those of Experiment 1, weakening the alternative explanation that the relationships between aesthetics and apparent usability are primarily the result of a response dependency bias caused by the method used in KK and in Experiment 1. Experiment 1's results, regarding apparent usability relationships with keypad type and number of groupings are also replicated here. Thus, experiment 2 lends further support to the overall strong correlation between apparent usability and aesthetics, and to the differences between Israelis and Japanese concerning these relationships.

Rank	Numeric Keyboard Type, KK vs. Exp. 1 (Japan/Israel)			
	Telephone	Calculator	Horizontal	Other
1 (Lowest)	0 / 0	1 / 1	0 / 3	1 / 1
2	2 / 4	4 / 4	0 / 1	0 / 0
3	7 / 8	1 / 1	0 / 0	0 / 0
4 (Highest)	6 / 3	0 / 0	4 / 0	0 / 0

**Table 2.** Ranking of Numeric Keyboard Types in Japan vs. Experiment 1 in Israel

### Experiment 3: Testing for medium bias

The two previous experiments—like KK's experiment—used an overhead projector to display the designs on a large screen. Participants saw the designs from different distances (which were generally large), and from different angles. The third experiment was designed to test whether judgments would differ if the ATM designs

were presented on a terminal display rather than on a large public screen. Working with personal computers had additional advantages from the experimenter's viewpoint. It increased the uniformity of the viewing conditions, enabled participants to work in their own pace, and allowed for full randomization of the stimuli presentation (i.e., both the order of the questions and the designs). Participants were 108 3rd year engineering students who participated in the study in part fulfillment of their requirements for an HCI course.

### Procedure

Participants were seated in front of a personal computer. A computer program, written in Visual Basic was used to present the stimuli material, accept user responses, and measure response times. The program started with a short on-line introduction, after which participants were presented with the 26 ATM designs. The designs were displayed in a random order. At the bottom of the screen, one of the two questions regarding aesthetics and apparent usability was presented. The participants answered the question on the 1-10 scale by selecting one of ten available response buttons. To proceed to the next design, they had to select a "Continue" button. After responding to the first question for all 26 designs, the 26 designs were presented once again (in a newly randomized order) and the participants answered the other question (apparent usability or aesthetics) for each design.

### Results

The results from Experiment 3 are presented in Table 1. By and large, the results are consistent with those obtained in Experiments 1 and 2, reinforcing the patterns observed thus far. The use of computers in this experiment allowed for the measurement of the time it took participants to evaluate the designs. On the average, people took more time to evaluate usability than aesthetics (mean evaluation times = 8.68 sec. vs. 7.58 sec. respectively;  $t=2.49$ ,  $df=107$ ,  $p=.014$ ). Though not very large, the difference in latencies supports the intuitive expectation that evaluating apparent usability is more complex, and hence more time consuming, than the evaluation of the interface aesthetics.

## DISCUSSION

The results of this study replicate the basic findings of Kurosu and Kashimura [12]. However, because of the unexpectedly high correlations between apparent usability and aesthetics found in Israel, it is still premature to rule out the possibility of method variance as a major cause of the obtained results. When traits are expected to correlate, it is preferable to add to the study traits that are expected to be independent of each other, in order to rule out method effects. Unfortunately, this

was not done in this case, because apparent usability and aesthetics were not expected to correlate in Israel (recall the original proposition of this study). Some support exists, though, for the dominance of true trait correlation between apparent usability and aesthetics. Table 3 presents the correlations obtained in the 3 experiments between these variables in a multitrait-multimethod matrix format [2]. The resulting matrix indicates that, at the very least, the results cannot be attributed solely to method variance. Clearly, all validity diagonals (italicized numbers) are very large, providing evidence of convergent validity (cf. [2]). Support for discriminant validity is more tentative. Each validity value is higher than the values lying in its column and row within the heteromethod blocks (enclosed by broken lines). On the other hand, to establish discriminant validity correlations of independent measures of the same trait (e.g., A1 and A2, U2 and U3) need to exceed the correlations between different traits measured by the same method (e.g., A1 and U1, A3 and U3). This happens in only 5 out of 12 comparisons. However, most violations of this requirement occur with comparisons that involve Experiment 1 (the experiment most likely to include method bias). Comparisons involving only Experiments 2 and 3 meet this requirements 3 out of 4 times. Thus, it appears that some method bias indeed existed in Experiment 1 and was removed in the subsequent experiments. Another argument for a true correlation of apparent usability and aesthetics stems from the fact that very similar results were obtained under three considerably different experimental contexts and procedures. Thus, it can be concluded with some confidence that despite the potential method bias, people's perceptions of apparent usability and aesthetics are quite high in general.

Unfortunately, the experiments reported above are too exploratory in nature to explain the process by which people associate usability and aesthetics. Nevertheless, the high correlations across cultures and experimental conditions challenge our assumptions regarding the dimensions of system acceptability in general and the relationships between aesthetics and usability in particular. The various design disciplines have long been occupied with the fragile equilibrium between form and function, aesthetics and usability (e.g. [23,25]). The field of HCI has taken an unequivocal stand on this matter, concentrating on usability. The results of this study, however, suggest that to achieve the ultimate goal of an acceptable system, a more balanced approach may be needed. The influence of attractive appearance on attitudes and behavior has been documented by social psychologists (e.g., [3, 19, 29]), and has been used by advertisers and persuaders of all sorts. The potential effect of aesthetic experience has not escaped software vendors as well, nor is it ignored by the trade literature in its evaluation of computer products. In their attempts to shift the balance back towards a more user-oriented — rather than customer-oriented — design, it seems that HCI researchers have thus far ignored the possible interplay between aesthetics and usability. Clearly, future research is needed to discriminate between different concepts of usability (for example, intended-, apparent-, and measured usability) and to evaluate the effects of aesthetics on each and on the overall acceptability of the system. The results obtained in this study, together with the potential effect of apparent usability on post-use satisfaction [10,13], strongly suggest that we pay more attention to people's perceptions of the interface aesthetics than we have done thus far. In a sense, this

		<u>Experiment 1</u>		<u>Experiment 2</u>		<u>Experiment 3</u>	
		U1	A1	u2	A2	u3	A3
<b>Experiment 1</b>							
Apparent Usability	U <sub>1</sub>	0					
Aesthetics	A1	.92	0				
<b>Experiment 2</b>							
Apparent Usability	U <sub>2</sub>	<b>.92</b>	<b>.79</b>	( )			
Aesthetics	A <sub>2</sub>	<b>.87</b>	<b>.90</b>	.83	0		
<b>Experiment 3</b>							
Apparent Usability	U <sub>3</sub>	<b>.77</b>	<b>.90</b>	<b>.89</b>	( )		
Aesthetics	A <sub>3</sub>	<b>.81</b>	<b>.85</b>	<b>.79</b>	<b>.94</b>	<b>.92</b>	<b>0</b>

**Table 3.** A multitrait-multimethod matrix presentation of apparent usability and aesthetics as measured in three experiments. The table is arranged according to Campbell and Fiske[2]. Validity diagonals are marked in bold italics; heteromethod blocks enclosed within broken lines.

study provides empirical support to Laurel's [15] call for asking "not what the users are willing to endure, but what the ideal user experience might be, and what sort of interface might provide it" (p. 69).

The other major finding of this study suggests that the degree to which aesthetics relate to apparent usability is culturally dependent. We hypothesized that Japanese are more sensitive to aesthetics than Israelis, and would therefore emphasize more the role of aesthetics in interface design. Apparently, this is not the case. In Israel, correlations between apparent usability and aesthetics were considerably higher than in Japan. Apparently, our knowledge of how culture-specific aesthetics affect HCI issues is still limited. Possibly, with greater aesthetic sensitivity come also greater sophistication and critical skills which perhaps allow the Japanese in KK's study to not completely associate aesthetics with apparent usability as did their Israeli counterparts. An alternative explanation can be based on the larger variability in scores exhibited by Israeli students. The tendency by Israelis to provide more extreme evaluations could be attributed to their tendency to freely express opinions and preferences [11]. Another possible explanation, suggested by an anonymous reviewer, relates the larger variance among Israeli participants to their more diverse cultural background. Thus, the relatively unrestricted range of ratings provided by the Israelis for both variables may have led to higher correlations between aesthetics and apparent usability. Clearly, relating aesthetics to HCI in general, and to cross-cultural issues in particular should benefit from a more disciplined approach than has been taken thus far. The HCI literature on cross-cultural issues is scarce and limited [20,26]. There is no theory of cross-cultural HCI, and recommendations are not based on thorough empirical investigations. Consequently, its usefulness is quite limited. For example, Graphical User Interfaces (GUIs), once considered a panacea for interface globalization, now appear to be just as culturally specific and limited as older interfaces. And attempts to apply rules of thumb for GUIs aimed at culturally diverse users have failed when tested empirically, as demonstrated effectively by Teasley et al. [31]. Thus, while cultural aesthetics might serve as a good starting point for a cross-cultural research agenda in HCI, developing a cross-cultural theory of HCI requires us to apply more rigorous research methods and to empirically test our hunches and conventional wisdom. Future research should also focus more on identifying and measuring relevant aesthetic components (cf. [5]) that might help explain our experience with, and evaluation of, computer aesthetics.

## CONCLUSION

This study was designed with the prospect of demonstrating that high correlations between aesthetics and apparent usability are culture specific. It was expected that the correlations in Israel would be lower than those obtained in Japan. Surprisingly, the results indicated the opposite. This leads to three major conclusions: First, aesthetic perception and its relations to HCI relevant constructs **are** culturally dependent. Second, our current knowledge limits our ability to accurately predict how culture **influences** HCI related issues. Third, the results provide further support for the contention that perceptions of interface aesthetic are closely related to apparent usability and thus increase the likelihood that aesthetics may considerably affect system acceptability. The first two conclusions call for future efforts in defining the areas in which culture interacts with the domain of HCI and in systematically studying these areas. The third conclusion postulates that objective measures of system behavior and use may not **suffice** in predicting system acceptability. Perhaps a more holistic approach towards understanding how people experience and judge information systems is needed [30].

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