A short version of the visual aesthetics of websites inventory

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Abstract

The present paper addresses a need for a brief assessment instrument to measure perceived visual aesthetics of websites. A short version of the Visual Aesthetics of Websites inventory (VisAWI, Moshagen and Thielsch, 2010) called VisAWI-S was developed and evaluated in three studies comprising 1,673 participants in total. The results indicate that the VisAWI-S is a reliable measure that captures a single dimension of perceived visual aesthetics and provides a good approximation to the full-length version. Convergent validity was established by a strong relationship to overall appeal. Evidence for divergent validity was obtained by weaker correlations to perceived usability, pragmatic quality, and quality of content as well as by absence of a significant correlation to participants' mood. In addition to this, the VisAWI-S was found to be substantially related to the intention to revisit a website. Overall, the results indicate that the VisAWI-S may gainfully be employed to measure perceived visual aesthetics of websites when assessment times must be kept to a minimum.

Keywords: aesthetics; assessment; beauty; measurement; website; VisAWI

1. Introduction

Research on human-computer interaction has increasingly recognized that user's needs go beyond usability and that it is necessary consider user experience as a whole (e.g., Hassenzahl and Tractinsky, 2006; International Organization for Standardization, 2009; van Schaik and Ling, in press). Particularly, users' reactions to the beauty of an interface have become a focus in the current research. Several studies suggest that such aesthetic evaluations are formed rapidly (e.g., Lindgaard et al., 2006; van Schaik and Ling, 2009; Thielsch and Hirschfeld, in press; Tractinsky et al., 2006) and have immediate consequences by critically affecting a variety of constructs such as perceived and actual usability (e.g., Moshagen et al., 2009; Sonderegger and Sauer, 2010; Tractinsky et al., 2000), satisfaction (e.g., Cyr et al., 2008; Lindgaard and Dudek, 2003), preference (e.g., Schenkman and Jönsson, 2000), and intention to revisit a site (e.g., Mahlke, 2002).

Given the importance of visual aesthetics in human-computer interaction, it is vital that it is adequately assessed. Following an interactionist view on aesthetics by regarding beauty as an immediate pleasurable subjective experience that is directed toward an object (Santayana, 1955; Reber et al., 2004), Moshagen and Thielsch (2010) provided an 18-item measure of perceived visual aesthetics of websites, which they called the Visual Aesthetics of Website Inventory (VisAWI). Construction of the VisAWI was based on interviews and on factors that have been empirically shown to critically affect visual aesthetics of human-computer interfaces. Four facets jointly representing a general higher order factor of perceived visual aesthetics were identified and validated in a series of seven studies. *Simplicity* comprises aspects related to the Gestalt psychologists' figural goodness concept (e.g., Arnheim, 1974) such as unity, homogeneity, clarity, orderliness, and balance. *Diversity* reflects aspects related to dynamics, variety, visual richness, creativity, interestingness, and novelty. *Colourfulness* taps aesthetic evaluations stemming from the selection, placement, and combination of colours. *Craftsmanship* reflects whether the site was designed with skill and care using modern technologies. Mirroring the interactionist view on aesthetics, the facets refer to objective properties of websites subject to idiosyncratic evaluations. The items contained in the VisAWI are shown in Table 1.

Table 1: English and German items of the full VisAWI.

No.	English translation	German original
	Factor 1: Simplicity	
1	The layout appears too dense. (r)	Das Layout wirkt zu gedrängt. (r)
5	The layout is easy to grasp.	Das Layout ist gut zu erfassen.
9	Everything goes together on this site. *	Auf der Seite passt alles zusammen. *
13	The site appears patchy. (r)	Die Seite erscheint zu uneinheitlich. (r)
17	The layout appears well structured.	Das Layout erscheint angenehm gegliedert.
	Factor 2: Diversity	
2	The layout is pleasantly varied. *	Das Layout ist angenehm vielseitig. *
6	The layout is inventive.	Das Layout ist originell.
10	The design appears uninspired. (r)	Die Gestaltung wirkt einfallslos. (r)
14	The layout appears dynamic.	Das Layout wirkt dynamisch.
18	The design is uninteresting. (r)	Die Seitengestaltung ist uninteressant. (r)
	Factor 3: Colourfulness	
3	The color composition is attractive. *	Die farbliche Gesamtgestaltung wirkt attraktiv. *
7	The colors do not match. (r)	Der Farbeinsatz ist nicht gelungen. (r)
11	The choice of colors is botched. (r)	Die Farben passen nicht zueinander. (r)
15	The colors are appealing.	Die Farben haben eine angenehme Wirkung.
	Factor 4: Craftsmanship	
4	The layout appears professionally designed. *	Das Layout ist professionell. *
8	The layout is not up-to-date. (r)	Das Layout ist nicht zeitgemäß. (r)
12	The site is designed with care.	Die Seite erscheint mit Sorgfalt gemacht.
16	The design of the site lacks a concept. (r)	Das Layout wirkt konzeptlos. (r)

Note. Negatively-keyed items are indicated by (r) and are reverse-scored. Items marked with an asterisk (*) are included in the shortened VisAWI-S.

Moshagen and Thielsch (2010) provided evidence for the construct validity by obtaining strong correlations to related (e.g., overall appeal), but weaker correlations to unrelated constructs (e.g., quality of content). The utility of the VisAWI in differentiating between different websites was demonstrated by showing that aesthetically pleasant and aesthetically unpleasant websites received very different scores, and that each facet of the VisAWI was responsive to changes in the design of a website. The purported factor structure was supported by means of confirmatory factor analyses. The emerged subscales contained in the VisAWI demonstrated good internal consistencies ($.85 \leq \alpha \leq .89$). The facet structure of the VisAWI was further supported by experimentally demonstrating that manipulations of the colour of a website selectively affected ratings on the Colourfulness facet, but showed no effect regarding the remaining facets. In summary, the results reported in Moshagen and Thielsch (2010) indicate that the VisAWI is a sound measure that allows for a reliable and precise assessment of perceived visual aesthetics of websites.

However, a shortcoming of the VisAWI is that its application may be too lengthy for certain research settings. For example, experiments that systematically manipulate visual aesthetics to determine its effect on other variables often require a simple manipulation check. In other studies, there may be a need for repeated assessment of different stimuli by the same individuals. Finally, some studies may not require detailed information on different facets of

visual aesthetics as provided by the VisAWI, but merely need a valid assessment of global visual aesthetics. In each of these scenarios, having participants to complete 18 items would be overly costly (in terms of time) and may even introduce systematic response biases (e.g., due to fatigue or poor motivation of participants, especially when multiple evaluations are made, see also Thielsch and Hirschfeld, in press). However, relying on just a single global item is also subject to serious drawbacks, as single-item measures compromise reliability, comparability across studies, and validity (Anastasi and Urbana, 1997; Kline, 2000; Nunnally and Bernstein, 1994; Schmidt and Hunter, 1996; Spector, 1992). For these reasons, it seems useful to develop a shortened brief version of the VisAWI tapping the general second order factor of visual aesthetics found by Moshagen and Thielsch (2010). Although a reduction in length is associated with discarding information regarding the facet structure, this would enable the use of the VisAWI when assessment times must be kept to a minimum. The remainder of this paper presents three studies on the development and validation of such a shortened version of the VisAWI.

2. Study I: Construction and initial evaluation of the brief VisAWI

The first stage of scale development was to identify items that capture the essence of the full VisAWI. Moreover, the unidimensionality of the measure was confirmed using confirmatory factor analysis methodology.

2.1 Methods

2.1.1 Participants

A total of 764 members of a German online access panel (53% female) participated in the web-based study. Age ranged from 14 to 86 years (M = 39.37; SD = 16.82). Participants completed the study on an anonymous and voluntary basis without any compensation.

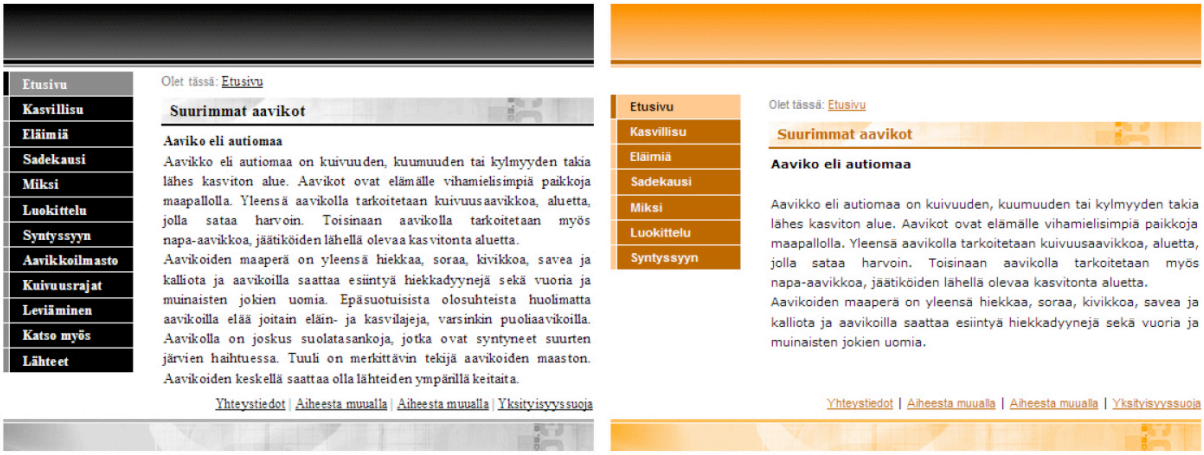
2.1.2 Procedures

After providing demographic background information, participants were shown a screenshot of the website to be evaluated along with the shortened version of the VisAWI (see below). The study took approximately 5 minutes to complete.

2.1.3 Materials

Participants randomly received one of 24 different mock websites. The mock sites differed in their colour scheme (grey / red / orange / light blue / dark blue / green / purple / rose), font (Verdana / Times New Roman), and complexity (low / high). To avoid effects of content and usability, the websites were given in Finnish language which looks similar to German with respect to text layout. Examples of the type of websites used are presented in Figure 1.

Figure 1. Examples for the mock websites used as stimulus materials in study 1.



2.1.4 Measures

Construction of a shortened version of the full VisAWI was guided by the following constraints: First, each facet contained in the VisAWI should be represented by at least one item. Second, the items should be as representative as possible for their associated facet. Finally, the brief version of the VisAWI should be as short as possible to allow its application when assessment times must be kept to a minimum. In order to meet these requirements, a 4-item version (VisAWI-S) was created such that each facet of the full VisAWI (Simplicity, Diversity, Colourfulness, Craftsmanship) was represented by one item. In order to ensure that each selected item is representative for its associated facet, items were chosen for further consideration if they showed high factor loadings in the studies reported in Moshagen and Thielsch (2010). Additionally, we (MM & MTT) carefully evaluated the content of the items and the associated facet to retain those items that most likely fully describe the associated facet.

This process eventually led to the selection of four items: (1) “Everything goes together on this site” representing the Simplicity facet,[1] (2) “The layout is pleasantly varied” representing the Diversity facet, (3) “The colour composition is attractive” representing Colourfulness, and (4) “The layout appears professionally designed” representing Craftsmanship. Comparable to the full VisAWI, participants were asked to indicate their level of agreement to each item on a 7-point Likert scale (ranging from 1 ‘strongly disagree’ to 7 ‘strongly agree’).

It should be noted that the remainder of this paper reports on the German-language version of the VisAWI. The English-language version (shown in Table 1) stems from a translation/back-translation process involving two bilingual speakers. First, one bilingual speaker translated the German original into English. This version was then independently back-translated into German by the second bilingual speaker who was blind to the original German-language version of the VisAWI. The authors (MM & MTT) and the involved

[1] At a first glance, it may appear counterintuitive how the item “Everything goes together on this site” maps onto the Simplicity facet. It is important to bear in mind that the Simplicity facet as conceptualized in the VisAWI relates to the Gestalt psychologists’ figural goodness concept, which is much broader than notions of simplicity in terms of overview or the use of few elements. This figural goodness concept entails aspects such as unity, homogeneity, clarity, orderliness, and balance. Thus, the chosen item appears well suited to represent the Simplicity facet in all its broadness.

translators jointly evaluated the equivalence of the back-translated and the original version and found these versions to be grammatically and semantically equivalent.

2.2 Results and Discussion

A confirmatory factor analysis was conducted on the item covariance matrix using Mplus 4.20 (Muthén and Muthén, 2008) in order to verify that the items reflect a single dimension. Accordingly, the model specified a single latent factor which was assigned a scale by fixing one unstandardized loading to one. The correlations between the item uniquenesses were constrained to zero. Parameter estimation of the factor model proceeded via maximum likelihood.

Confirmatory factor analysis on the four items representing the latent general factor of visual aesthetics yielded an excellent fit to the data, $\chi^2(2) < 2$, indicating that there were no significant departures from the specified model and the model in the population. Factor loading estimates ranged from .67 to .79. Cronbach's coefficient of internal consistency was high, $\alpha = .81$. These results clearly confirm the unidimensionality of the VisAWI-S.

3. Study II: Convergent, divergent, and concurrent validation

The second stage of scale development was to investigate convergent and divergent validity patterns of the shortened version of the VisAWI. Convergent validity refers to the extent of agreement of various measures of theoretically related constructs and was examined by exploring the relationship of the VisAWI-S with a measure of overall appeal. Divergent (or discriminant) validity is the degree of disagreement of theoretically unrelated (or theoretically less related) constructs (e.g., Nunnally and Bernstein, 1994). Divergent validity was investigated by correlating the VisAWI-S to measures of perceived usability, pragmatic quality, quality of the content of a website, and users' mood before being exposed to the website. Concurrent validity refers to the associations of a measure with a concurrently assessed criterion. Concurrent validity was examined by correlating the VisAWI-S scores with participants' intention to revisit the website. It was expected that the VisAWI-S is highly correlated ($r > .5$) with convergent measures, weakly correlated ($r < .3$) with divergent measures, and substantially (but not necessarily highly) correlated ($r > .3$) with the criterion (intention to revisit the website).

3.1 Methods

3.1.1 Participants

A total of 305 German native speakers (71.1 % female) volunteered to participate in the study. Age ranged from 18 to 59 years ($M = 26.20$; $SD = 7.93$). Participants completed the study on an anonymous basis and received course credits (if required) for their participation.

3.1.2 Procedures

After providing demographic background information, participants completed a mood questionnaire (see below). Afterwards they entered a screen that was split into two parts such that participants simultaneously viewed the full functioning website and the items. The small upper panel showed the items, while the bigger lower panel showed the website to be evaluated. The questionnaires were presented in randomized order, as were the items within each questionnaire. Except for the AttracDiff and the MDBF questionnaires (see below), participants were asked to indicate their level of agreement to each item on a 7-point Likert

scale (ranging from 1 ‘strongly disagree’ to 7 ‘strongly agree’). Completing the study took approximately 15 minutes.

3.1.3 Materials

A set of ten German websites including representing corporate websites, e-commerce, e-recruitment, entertainment, information sites, search engines, and web portals was used as stimulus materials. This set represents a broad range of German institutional and corporate websites.

3.1.4 Measures

VisAWI-S. The 4-item version was used.

AttracDiff. The present study used two scales of the AttracDiff questionnaire (Hassenzahl et al., 2003). The pragmatic quality scale aims to measure features that allow for efficient and effective goal achievement. The scale measuring appeal is considered to represent the overall attractiveness of a website. Pragmatic quality and appeal are assessed by 7 adjective pairs each (e.g. “simple - complex” or “pleasant – unpleasant”).

Perceived website usability. The scale measuring perceived website usability (Flavián et al., 2006) is a seven-item measure assessing perceived ease of use, ease of understanding and speed of information retrieval.

Quality of content. This quality-of-content questionnaire (Thielsch, 2008) comprises nine items (three on each subscale) assessing interestingness, comprehensibility, and perceived usefulness of a website’s content.

Multidimensional Mood State Questionnaire (MDBF). The short version of the MDBF (Steyer et al., 1997) contains the subscales mood level, mood reactivity, and restlessness. The scales are assessed by 4 adjectives each (e.g., “happy”, “alert” or “nervous”) with a 5-point intensity scale ranging from l (“not at all”) to 5 (“very much”).

Intention to revisit. The intention to revisit the website was assessed by a composite index consisting of the following items: (1) “I will visit the website again”, (2) “I will visit the website on a regular basis”, (3) “I would recommend the website to my friends”, (4) “If I had interest in the content of the website in future, I would consider visiting the website”.

3.2 Results and Discussion

The VisAWI-S exhibited a strong correlation to the scale measuring overall appeal ($r = .72$, $p < .01$) indicating convergent validity. The correlations to divergent measures were lower, but in parts still mediocre to high: Correlations to the scale measuring perceived website usability and to the pragmatic quality scale of the AttracDiff were $r = .54$ and $r = .53$, respectively (both $p < .01$). Mediocre correlations were found to the different aspects of content evaluation: interestingness ($r = .49$, $p < .01$), comprehensibility ($r = .34$, $p < .01$), and perceived usefulness ($r = .41$, $p < .01$). Participants’ mood state before being exposed to the website was not related to the VisAWI-S. Correlations to mood level ($r = -.06$), mood reactivity ($r = -.07$), and restlessness ($r = -.05$) were not significant. With respect to concurrent validity, the correlation of the VisAWI-S and the index of participants’ intention to revisit the website was $r = .52$, $p < .01$. The proportion of variance explained in the criterion thus was $R^2 = 27\%$.

Whereas the VisAWI-S showed good convergent and satisfactory concurrent validity, the results concerning divergent validity were mixed. While there was no significant correlation to participants' mood state before evaluating the website, medium to high correlations were evident to measures of perceived usability, pragmatic quality, and evaluations of the quality of content. However, this latter pattern of results closely mirrors the one obtained in the construction of the full length version of the VisAWI (Moshagen and Thielsch, 2010). Moshagen and Thielsch (2010) argued (and subsequently demonstrated) that the rather high correlations to divergent constructs are likely due to a strong halo effect. As there where no specific use tasks given to the participants in the current study, it is possible that participants' evaluations of usability and content were strongly influenced by visual aesthetics (see also, Tractinsky et al., 2000). In addition, moderate associations between perceived usability and visual aesthetics may reflect that certain attributes of websites enhance both, aesthetics and usability (Karvonen, 2000; Lavie and Tractinsky, 2004). Nevertheless, as the VisAWI-S comprises only four items, it may be more prone to halo-effects than the full VisAWI.

4. Study III: Comparison with the full VisAWI

The purpose of the final study was to investigate the extent of agreement between the shortened and the full VisAWI. Construction of the VisAWI-S proceeded in a way such that it should capture the same higher order construct of visual aesthetics as measured by the full VisAWI. Thus, it was expected that the shortened and the full VisAWI are highly related.

4.1 Methods

4.1.1 Participants

A total of 604 German native speakers volunteered to participate anonymously in the study. Of the participants, 411 (68%) were female. Mean age was 25.67 (*SD* = 7.28) years. Age ranged from 17 to 79 years.

4.1.2 Procedures

After providing demographic background information, participants entered a screen that was split into two parts. The website to be evaluated was displayed in the lower panel. The upper panel randomly showed one item at a time. The study took approximately 5 minutes to complete.

4.1.3 Materials

Participants randomly received one out of 50 websites from the pool of websites described in Thielsch and Hirschfeld (2010). This pool represents a wide range of German institutional and corporate websites, including corporate websites, e-commerce, e-learning, e-recruitment, entertainment, information sites, search engines, social software, and web portals (for more details, see Thielsch and Hirschfeld, 2010, p. 974).

4.1.4 Measures

The full 18-item version of the VisAWI was used (see Table 1). Scores for the VisAWI-S were obtained by using only responses to the four items included in the VisAWI-S.

4.2 Results and Discussion

The means and standard deviations as well as Cronbach's coefficient of internal consistency are shown in Table 2. The correlation between the full 18-item VisAWI and the shortened brief 4-item version was very high, $r = .91$, $p < .01$. In order to examine whether the VisAWI-S is also able to reproduce the rank order of the websites, Spearman's rank correlation coefficient was computed between the page ranks obtained with the full and the shortened version of the VisAWI. The rank correlation coefficient was very high, $rho = .95$, $p < .01$. These results show that, overall, the VisAWI-S is able to provide a very close approximation to perceived visual aesthetics as measured by the full VisAWI.

A comparison of the reliability estimates indicate that using the VisAWI-S is associated with a loss in precision. Given the great reduction in the number of items, it is not surprising that the VisAWI-S has a lower reliability compared to the full length version. Importantly, however, Cronbach's alpha indicates that the shortened scale is still sufficiently reliable for most purposes. Comparing the means shows that the websites tend to receive significantly lower scores on the VisAWI-S as compared to the full VisAWI, $t(604) = 7.93$, $p < .01$. Nevertheless, according to the standardized mean difference Cohen's d (Cohen, 1988), the mean differences of the full and the brief VisAWI can be regarded as small ($d = 0.14$).

Table 2: Scale statistics of the full and the shortened versions of the VisAWI

	Mean	SD	α	Min	Max
Full VisAWI	4.03	1.18	.92	1.17	6.78
VisAWI-S	3.86	1.23	.76	1.00	7.00

5. General Discussion

Given a need for a brief and validated instrument to assess perceived visual aesthetics of websites, the present paper provided a 4-item version of the Visual Aesthetics of Websites inventory (VisAWI; Moshagen and Thielsch, 2010) called VisAWI-S. It was shown that the VisAWI-S is a reliable measure that adequately captures a single dimension of perceived visual aesthetics. Convergent validity was established by a strong correlation to a measure of overall appeal. Divergent validity was demonstrated by weaker correlations to measures of perceived usability, pragmatic quality, and three aspects of quality of website content. Moreover, there was no significant relationship between the VisAWI-S and participants' mood prior exposure to the website being evaluated. In addition to this, the VisAWI-S was found to be highly related to the intention to revisit a website, providing evidence concerning concurrent validity of the VisAWI-S. Finally, strong correlations between the shortened and the full-length version indicated that the VisAWI-S is able to provide a close approximation to results obtained with the full VisAWI.

Both the full VisAWI and the shortened VisAWI-S have been developed using websites only. Also, some items of these instruments genuinely refer to websites. However, an increasingly important issue pertains to visual aesthetics of other human-computer artifacts such as interfaces of software programs and mobile devices. As the boundaries between websites and software interfaces tend to diminish, current differences in the layout of various human-computer interfaces (for example regarding the use and customizability of dialogues) are likely to become of even lesser importance. In general, it is reasonable to assume that the

structure of visual aesthetics – if at all – only marginally differs across different human-computer interfaces. Also, the factors underlying the VisAWI are of sufficient generality to ensure applicability to other human-computer artifacts. Thus, we believe that the VisAWI(-S) can be used to measure visual aesthetics of any human-computer interface, subject to minor changes in the wording of items that explicitly refer to websites (see Choi and Lee, 2012, for an application of the VisAWI to interfaces of smartphones).

The shortened version of the VisAWI developed in the present paper is also subject to several drawbacks, however. Obviously, the VisAWI-S necessarily cannot provide any information on the facets underlying visual aesthetics of websites Simplicity, Diversity, Colourfulness, and Craftsmanship. For a more detailed assessment or when needing information of a particular facet (such as when applying a colour manipulation), the full VisAWI is to be preferred. Furthermore, as a result of the reduced length, the reliability of the shortened version is lower, although the results also indicate that the VisAWI-S is still sufficiently reliable for most purposes. Some more general limitations should also be acknowledged. Neither the participants nor the websites used in the present studies were representative for the general population of internet users and the myriad of websites, respectively. A related issue is that the participants of the present studies share a common cultural background. In addition, the items of both the full length VisAWI and the shortened VisAWI-S were originally developed in German language. Although we are confident regarding the quality of the English translation and also expect the main results can be generalized to the English language version, establishment of measurement equivalence is ultimately an empirical issue that remains to be investigated in future studies. Accordingly, the psychometric properties and validity of the VisAWI-S remain to be generalized to other groups of participants, languages, and to other contexts, including human-computer interfaces different from websites.

These limitations notwithstanding, the results reported in the present paper demonstrate that the VisAWI-S may serve as an accurate proxy for the full VisAWI and may gainfully be employed to measure perceived visual aesthetics of websites when assessment times must be kept to a minimum.

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References

Arnheim, R., 1974. *Art and visual perception: A psychology of the creative eye*. Berkeley: University of California Press.

Anastasi, A. and Urbana, S., 1997. *Psychological Testing*. Upper Saddle River: Prentice-Hall.

Choi, J. H. and Lee, H.-J., 2012. Facets of simplicity for the smartphone interface: A structural model. *International Journal of Human-Computer Studies*, *70*, 129-142.

Cohen, J., 1988. *Statistical power analysis for the behavioral sciences*. Mahwah: Erlbaum.

Cyr, D., Kindra, G. S., and Dash, S, 2008. Web site design, trust, satisfaction and e-loyalty: The Indian experience. *Online Information Review*, 32, 773-790.

Flavián, C., Guinalíu, M., and Gurrea, R., 2006. The role played by perceived usability, satisfaction and consumer trust on website loyalty. *Information & Management*, 43, 1-14.

Hassenzahl, M., Burmester, M., and Koller, F., 2003. AttrakDiff: Ein Fragebogen zur Messung wahrgenommener hedonischer und pragmatischer Qualität [AttrakDiff: A questionnaire for the measurement of perceived pragmatic and hedonic quality]. *In:* J. Ziegler and G. Szwillus, eds. *Mensch & Computer*. Stuttgart: Teubner, 187–196.

Hassenzahl, M. and Tractinsky, N., 2006. User experience - a research agenda. *Behaviour & Information Technology*, 25, 91-97.

International Organization for Standardization, 2009. *ISO FDIS 9241-210: Ergonomics of human system interaction - Part 210: Human-centred design for interactive systems*. Geneva: International Organization for Standardization.

Karvonen, K., 2000. The beauty of simplicity. *ACM Proceedings on the 2000 conference on Universal Usability* (pp. 85-90). New York: ACM Press.

Kline, P., 2000. *The handbook of psychological testing*. London: Routledge.

Lavie, T., and Tractinsky, N., 2004. Assessing dimensions of perceived visual aesthetics of web sites. *International Journal of Human-Computer Studies*, *60*, 269-298.

Lindgaard, G. and Dudek, C., 2003. What is this evasive beast we call user satisfaction? *Interacting with Computers*, 15, 429-452.

Lindgaard, G., Fernandes, G., Dudek, C., and Brown, J., 2006. Attention web designers: You have 50 milliseconds to make a good first impression! *Behaviour & Information Technology*, 25, 115-126.

Mahlke, S., 2002. Factors influencing the experience of website usage. *In*: *CHI '02 extended abstracts on Human factors in computing systems*. Minneapolis: ACM, 846-847.

Moshagen, M., Musch, J. and Göritz, A. S., 2009. A blessing, not a curse: Experimental evidence for beneficial effects of visual aesthetics on performance. *Ergonomics*, 52, 1311-1320.

Moshagen, M. and Thielsch, M. T., 2010. Facets of visual aesthetics. *International Journal of Human-Computer Studies*, 68, 689-709.

Muthén, L. K. and Muthén, B. O., 2008. *Mplus user's guide*. Los Angeles: Muthén & Muthén.

Nunnally, J.C. and Bernstein, I.H., 1994. *Psychometric theory*. New York: McGraw-Hill.

Reber, R., Schwarz, N. and Winkielman, P., 2004. Processing fluency and aesthetic pleasure: Is beauty in the perceiver's processing experience? *Personality and Social Psychology Review*, 8, 364-382.

Santayana, G., 1955. *The sense of beauty*. New York: Dover.

Schenkman, B. and Jönsson, F., 2000. Aesthetics and preferences of web pages. *Behaviour & Information Technology*, 19, 367-377.

Schmidt, F.L. and Hunter, J.E., 1996. Measurement error in psychological research: Lessons from 26 research scenarios. *Psychological Methods*, 1, 199-223.

Sonderegger, A. and Sauer, J., 2010. The influence of design aesthetics in usability testing: Effects on user performance and perceived usability. *Applied Ergonomics*, 403-410.

Spector, P.E., 1992. *Summated rating scale construction: An introduction.* Newbury Park: Sage.

Steyer, R., Schwenkmezger, O., Notz, P. and Eid, M., 1997. *Der Mehrdimensionale Befindlichkeitsfragebogen (MDBF) [Multidimensional Mood State Questionnaire]*. Göttingen: Hogrefe.

Thielsch, M. T., 2008. *Ästhetik von Websites [Aesthetics of websites]*. Münster: MV Wissenschaft.

Thielsch, M. T. and Hirschfeld, G., 2010. High and low spatial frequencies in website evaluations. *Ergonomics*, 53, 972-978.

Thielsch, M. T. and Hirschfeld, G., in press. Spatial frequencies in aesthetic website evaluations – explaining how ultra-rapid evaluations are formed. *Ergonomics*.

Tractinsky, N., Cokhavi, A., Kirschenbaum, M. and Sharfi, T., 2006. Evaluating the consistency of immediate aesthetic perceptions of web pages. *International Journal of Human-Computer Studies*, 64, 1071-1083.

Tractinsky, N., Katz, A., and Ikar, D., 2000. What is beautiful is usable. *Interacting with Computers*, 13, 127-145.

van Schaik, P. and Ling, J., 2009. The role of context in perceptions of the aesthetics of web pages over time. *International Journal of Human-Computer Studies*, 67, 79-89.

van Schaik, P. and Ling, J., in press. An experimental analysis of experiential and cognitive variables in web navigation. *Human-Computer Interaction*.