

# **The influence of visual complexity and prototypicality on credibility judgments of websites**

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**Abstract**

The present study analyzes the influence of visual complexity (VC) and prototypicality (PT) as design factors of websites on credibility judgments about these websites. To do so, participants had to rate company websites (varying in VC and PT) on perceived credibility. 76 websites had to be rated, but for different presentation times (17 ms, 33 ms, 500 ms and 5000 ms). With increasing presentation time, credibility judgments get closer to the judgment of the 5000 ms condition, which was used as a reference condition. Results also reveal that namely PT influences the reference condition, indicating a role of visual features in the synthesis of credibility judgments of websites.

## **Introduction**

First impressions of websites seem to be crucial in judging various aspects like aesthetics, credibility and hedonic quality. Recent research shows that first impressions of websites form stable judgments of, for instance, aesthetics (e.g. Lindgaard, Fernandes, Dudek, & Brown, 2006; Tuch, Roth, Hornbæk, Opwis, & Bargas-Avila, 2012). Studies of aesthetic judgments on interactive products are part of a relatively new approach, which is known as User Experience (UX). The purpose of this approach is to study usability of products. As opposed to traditional usability research, which focuses on task- and work-efficiency, UX envelops an experiential and non-instrumental view on interactive products. This approach is also getting more popular in the field of Human-Computer Interaction (HCI). Hence, UX has received much attention in the past decade and many studies have been published in this domain (e.g. Hassenzahl & Monk, 2010; Lavie & Tractinsky, 2004; Moshagen & Thielsch, 2010; Tuch, Presslaber, Stöcklin, Opwis, & Bargas-Avila, 2012).

A recent study in the area of UX examined the role of visual complexity (VC) and prototypicality (PT) as design factors of websites (Tuch, Presslaber, et al., 2012). Tuch and his colleagues performed two studies on this topic. The first study consisted of 119 screenshots of real websites. Different conditions were tested, in which VC varied between low, medium and high and PT varied between low and high. Participants were asked to rate each website on perceived aesthetics. As a between-subject factor, the presentation time of each screenshot of a website was varied (50 ms, 500 ms and 1000 ms). They reached the conclusion that low visual complexity and high prototypicality tend to trigger the most beautiful judgments of websites. This effect was stable even in the 50 ms condition, indicating first impressions that are formed very quickly as being able to form stable aesthetic judgments. The second study's goal was to further shorten the presentation times of the stimuli. The authors used presentation times of 17, 33 and 50 ms as the between-subject factor. Results from this study provide evidence that VC and PT affect aesthetic judgment even at the presentation time of 17 ms. It should be noted that the effect of VC was more pronounced in this condition than the effect of PT. This finding is consistent with the model of aesthetic experience by Leder, Belke, Oeberst and Augustin (2004).

In addition to aesthetics, numerous other factors are tested in the UX approach; for example hedonic quality (e.g. Hassenzahl, Platz, Burmester, & Lehner, 2000), fun (e.g. Sim, MacFarlane, & Read, 2006) and trust (e.g. Christophersen & Konradt, 2012). For an overview of UX factors, see Bargas-Avila and Hornbæk (2011). Another major factor in the UX ap-

proach is credibility. Robins and Holmes (2008), for example, analyzed the relationship between aesthetics and credibility of websites, using different aesthetic treatments. They reached the conclusion that websites with a higher aesthetic treatment are judged as having higher credibility. Despite the growing interest in UX in the HCI field, no one to the best of my knowledge has studied the effects of VC and PT on credibility. The aim of this study is to broaden current knowledge of the effects of VC and PT, originating from the research of Tuch, Presslauer et al. (2012). In this study, the research of Tuch and his colleagues will be replicated and slightly modified. Replication and extension of existing studies is useful in the way that it can strengthen the validity and generalizability of these studies (Hubbard & Armstrong, 1994). Its purpose will be to explore how VC and PT influence credibility judgments.

## **Theoretical framework**

### *First impression*

As outlined in the previous section, a growing body of literature has examined the importance of first impressions of websites (e.g. Lindgaard, Fernandes, Dudek, & Brown, 2006; Tractinsky, Cokhavi, Kirschenbaum, & Sharfi, 2006; Tuch, Roth, et al., 2012; Tuch, Presslauer, et al., 2012). For instance, the study by Lindgaard et al. (2006) showed that stable judgments of aesthetics can be made within 50 ms. This finding suggests that first impressions of websites are crucial to judging aspects of user experience. Tuch, Presslauer et al. (2012) found that stable aesthetic judgments are already made at 17 ms.

Using the model of aesthetic experience by Leder et al. (2004), Tuch, Presslauer et al. (2012) hypothesized that the first two stages of the model (illustrated in Fig. 1) may play an important role in first impressions. Although this model was developed for perceptions of art, they argued that the first two stages would also be applicable for research on first impressions. The first stage consists of perceptual analyses, where the stimulus is perceptually analyzed. This analysis uses physical features such as visual complexity (VC). Results from Tuch, Presslauer et al.'s study (2012) showed that VC affects aesthetic judgments of websites at presentation times of 17 ms. In the first stage of the model (perceptual analyses), it can thus be stated that it takes 17 ms (maybe even less) to form an aesthetic judgment using VC. Once the stimulus is perceptually analyzed, the next stage starts.

In the second stage (implicit information integration), the previous experiences of the

perceiver are used to form a judgment. Main features in this stage are familiarity and prototypicality.

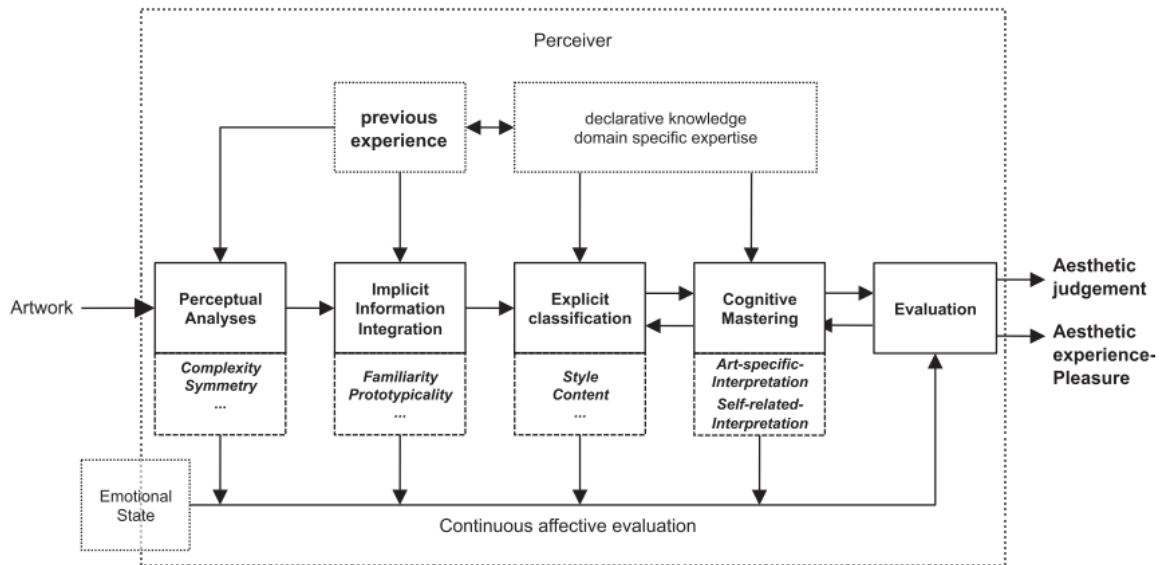


Fig. 1. Model of aesthetic experience (Leder et al., 2004)

Turning again to Tuch, Presslaber et al.'s study (2012), the effect of PT was less pronounced than the effect of VC in the 17 ms condition. In the 33 ms condition of their study, the effect of PT was stable. This seems to imply that stable judgments of aesthetics of websites, also using prototypicality as a feature, can be formed between 17 and 33 ms. Thus, in the implicit information integration stage, it can be stated that it probably takes between 17 and 33 ms to form an aesthetic judgment using PT and VC. It should be noted that the emotional state in which the perceiver is at a given time can influence the aesthetic judgment that perceiver makes. Leder et al. (2004) propose that the result of every stage in the aesthetic experience model can increase or decrease the affective state. They also believe that the perceiver evaluates his affective state and uses this information to stop the processing once the perceiver is in a satisfactory state. Leder et al. (2004) refer to the Affect Infusion Model (Forgas, 1995). This model suggests that the mood a person is in at the beginning of an aesthetic experience affects the quality of aesthetic processing.

### *Visual Complexity and Prototypicality*

According to the model of aesthetic experience (Leder et al., 2004), visual complexity is a key feature in establishing first impressions. One of the first studies of visual complexity and websites showed that visual complexity of websites influences the user's arousal, valence and heart rate (Tuch, Bargas-Avila, Opwis, & Wilhelm, 2009). More recently, Tuch, Presslaber et

al. (2012) analyzed the role of visual complexity and prototypicality on aesthetic judgments. Their results suggest that low VC and high PT lead to the most positive aesthetic judgments. In Veryzer, Jr. and Hutchinson (1998), the authors studied the effects of unity and prototypicality on aesthetic responses to new product designs. They found that prototypicality has a positive effect on aesthetic responses. These studies provide more evidence that visual complexity and prototypicality play a role in forming aesthetic judgments.

#### *Explicit Classification, Cognitive Mastering and Evaluation*

Leder et al.'s (2004) model includes two more stages which affect judgments of beauty. The third stage is explicit classification. In this stage and the next, explicit knowledge and expertise are involved. These explicit classifications are deliberate and can be verbalized (Leder et al., 2004) and in this stage the content and style of the stimulus are analyzed. Processing the style of a stimulus becomes more and more dominant with increasing expertise (Leder, Carbon, & Ripsas, 2006). A study on the difference between expert and non-expert perceivers of art states that experts value originality a lot more than non-experts. Non-experts tend to value craftsmanship and quality over originality (Hekkert & Van Wieringen, 1996). Although Leder et al.'s (2004) model is based on the aesthetic judgments of art, they claim that recognition of style is not exclusive to domains of art, so it may very well be usable in judgments of other domains as well, for example websites.

The fourth stage of the model of aesthetic experience is cognitive mastering. This stage is linked with the evaluation stage (the fifth stage). Cognitive mastering is about interpretation and understanding of, in Leder et al.'s (2004) case, art. In their paper, Leder and his colleagues claim that the results from the cognitive mastering stage are constantly evaluated. The evaluation stage thus is a guide for the processing of aesthetic judgments and experience. Information keeps being processed because of the evaluative loop. A judgment can then be made when the results of the evaluation stage are experienced as successful. When this is not the case, the processing can be redirected to previous stages in the model to come to a successful judgment and experience. In an experiment by Leder, Carbon and Ripsas (2006), titles were given to paintings. Leder and his colleagues used elaborative and descriptive titles. Elaborative titles provide a possible interpretation of an artwork and descriptive titles contain the most important features of the painting. In their first experiment they found that elaborative titles given to paintings increase the rating of understanding of those paintings. Descriptive titles in the first experiment decreased cognitive and affective evaluations. Leder et al.

(2006) state that it is possible that descriptive titles reduce meaning of the stimulus and thus makes it less interesting. Processing of the content (explicit classification, stage three) and meaning (cognitive mastering, stage four) might be interrupted because of trivial content (Leder et al., 2004). Presumably, descriptive titles affect the stage of explicit classification as well. Both titles can affect the stage of cognitive mastering. With trivial descriptive titles then, it might be that perceivers do not go beyond the third stage for their judgments. Their second experiment consisted of two conditions differing in presentation time. In the first condition the presentation time was restricted to 1 s. Results show that elaborative titles did not improve ratings of understanding. Furthermore, descriptive titles resulted in higher values of understanding. In the second condition the presentation time was increased to 10 s. In this condition, elaborative titles did improve understanding ratings. It seems that 1 s is not quite enough time for cognitive mastering to affect aesthetic processing. Understanding, according to Leder et al. (2006), presumably takes more time because it is based on explicit knowledge and explicit processes. With a presentation time of 1 s, judgments seem to be based on earlier stages of the model. Leder and his colleagues indeed conclude that in the 1 s condition it was only possible for the early stages (e.g. perceptual analyses and identifying the content) to be finished. This presumably means that the explicit classification stage takes place in 1 s or less and that the cognitive mastering stage takes place in a time between 1 s and 10 s.

*Timescales on the Leder et al. (2004) model of aesthetic experience*

Put together, it is now possible to add a timescale to the model of aesthetic experience, proposed by Leder et al. (2004). In Fig. 2 the model is illustrated with added timescales. The evaluation time would be dependent on how many stages have been successfully finished. As stated in the previous sections, perceptual analyses (stage one) take place in 17 ms or less and implicit information integration (stage two) takes places between 17 and 33 ms. Explicit classification (stage three) probably takes place in 1 s or less and cognitive mastering presumably occurs between 1 and 10 s. This timescale shows a rather serial path of making aesthetic judgments. This is not necessarily the case in forming judgments of, for instance, aesthetics (Leder et al., 2004). They argue that, particularly in modern art, novices to art (non-experts) could be using stereotypes and thus will not go through the complete model of aesthetic processing. They may make judgments of aesthetics depending solely on the first stages. Leder and his colleagues use the example of the classification “abstract” of an artwork. This classification can already stop people from going through all the stages and result in a fast judgment.



Another example is personal taste. This can also have a strong influence in the making of certain judgments.

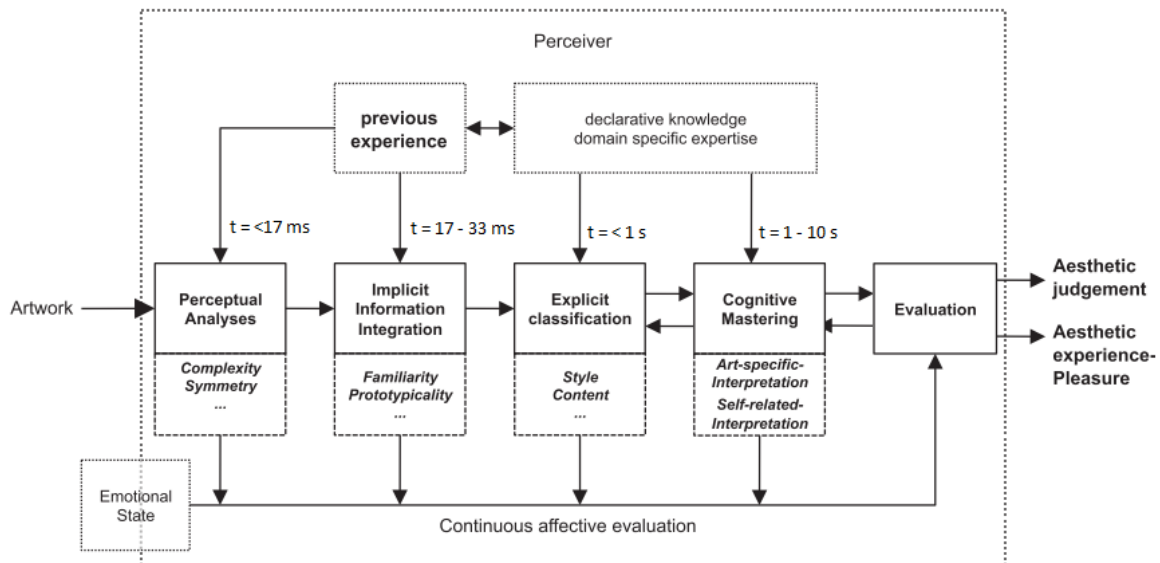


Fig. 2. Model of aesthetic experience by Leder et al. (2004) with added timescales.

### *Credibility*

Credibility is often used as a synonym for believability (e.g. Johnson & Kaye, 2002; Tseng & Fogg, 1999). In this study credibility is indeed defined as the believability of a website. Robins and Holmes (2008) studied the relation between aesthetics and credibility in the design of websites. Results show that people in the high aesthetic treatment generally make more positive judgments of credibility. Robins and Holmes named this the *amelioration effect* of visual design and aesthetics on credibility. Credibility judgments can be made by using heuristics (low effort, fast) or by using a systematic way focusing on content (relatively high effort, slow) (e.g. Menchen-Trevino & Hargittai, 2011). Comparing this to the model of aesthetic experience by Leder et al. (2004), it might very well be that the first 2 stages of the model focus on heuristic processing and that the later stages focus more on a systematic way of processing.

### *Research Question*

This study will shed light on the effects of VC and PT in the formation of credibility judgments. Since Tuch, Presslaber et al. (2012) found that VC and PT influence beauty judgments and that Robins and Holmes (2008) found that visual design and aesthetics have a positive

effect on credibility, we expect VC and PT to influence credibility judgments as well. The present study tries to explore how much credibility is influenced by early stages of visual processing.

## **Method**

### *Design*

Our experimental setup bears close resemblance to the one proposed by Tuch, Presslauer, et al. (2012). In this study a variation of their procedure was used. Specifically, this study consists solely of within-subject independent variables (i.e. repeated measures design). These independent variables included *visual complexity* (low and high), *prototypicality* (low and high) and *presentation time* (17 ms, 33 ms, 500 ms, 5000 ms). Perceived credibility was used as the dependent variable.

### *Participants*

A total of  $n = 25$  participants (15 female and 10 male) co-operated in the experiment. 21 participants were undergraduate students at the University of Twente. Three participants were attending higher level secondary school and one participant quit studying after high school. The mean age of the participants was 21.9 years ( $SD = 3.26$ ,  $Min = 17$ ,  $Max = 31$ ). Participants of behavioral sciences could receive 1 credit for participating in our research.

### *Materials*

Free software, retrieved from <http://www.psychopy.org/>, was used to create the experiment and gather data. The experiment was conducted using a 17" TFT monitor with a 60 Hz refresh frequency. TFT-screens were used in this study because research has shown that legibility is better on TFT-screens than on, for instance, CRT-screens (Nose et al., 1999; Shieh & Lin, 2000). The experiment was conducted at a resolution of 1000 x 800 pixels.

### *Stimuli selection*

The same stimuli as in Tuch, Presslauer et al.'s (2012) study are used in this experiment. They used screenshots of company websites, because a study by Roth, Schmutz, Pauwels, Bargas-Avila, & Opwis (2010) has shown that people have a consistent mental model of such websites. Tuch and his colleagues started with a pool of 464 websites. They excluded web-

sites with, for example, advertisements or a language other than English or German, which lead to a pool of 270 websites. After that, 267 participants of an online survey rated the 270 websites on visual complexity and prototypicality. Those scores led to a final pool of 120 websites, differing in low vs. medium vs. high visual complexity and low vs. high prototypicality. However, the present study does not use stimuli with a medium level of VC, because it has been shown that this level was of no further need due to a linear relation between VC and beauty (Tuch, Presslauer, et al., 2012). Eventually, 76 websites are used in this study differing in low and high VC and low and high PT.

### *Rating*

To assess the perceived credibility of the stimuli, a visual analogue scale (ranging from 0 to 1) was used with the following anchors: “Untrustworthy/Trustworthy”, “Unbelievable/Believable”, “Inaccurate/Accurate”, “Dishonest/Honest” and “Does not report the whole story/Reports the whole story”. These items were taken from a study by Abdulla, Garrison, Salwen, Driscoll, & Casey (2002), who did a factor analysis for online credibility. We translated the items used in their research to Dutch to be used in the experiment (see Table A1 [in Appendix A]).

### *Procedure*

The experiment has been conducted one person at a time in a small separate room at the University of Twente using the same computer. Participants were seated in front of a computer, and were asked for their gender, age and education. Before the experiment started, participants were asked to rate the scales intuitively. Further instructions were given on screen during the experiment. Participants started with a brief “practice phase”, in which several images were shown for different presentation times. After each image, participants had to make a judgment ranging from negative to positive on a visual analogue scale. This judgment was made using the computer mouse. After finishing the “practice phase”, the experiment started. The experiment consisted of 76 images of websites, which were shown in a random order to participants for 17 ms in the first block. Goldstein (2010) has shown that the representation of visible stimuli in the brain persists for approximately 250 ms after the stimuli disappeared (“Persistence of Vision”). Therefore, a visual mask was used to ascertain the accuracy of presentation times. After the visual mask, a random item from the credibility or hedonic quality scale had to be rated on a visual analogue scale ranging from negative to positive. After the

participants had rated all the websites, the same 76 websites were shown again for 33 ms, 500 ms and 5000 ms in the second, third and fourth block respectively.

### *Analysis*

To test to what extent VC and PT influence judgments of credibility, several regression analyses were done. Data was analyzed using IBM SPSS Statistics 21.0. In IBM SPSS, the linear regression was performed using the Generalized Estimating Equations command. Before this was done, visual complexity was reversed into visual simplicity (VS). This was because VC is known to negatively affect aesthetic judgments. In addition, the last and longest presentation time condition (5000 ms) was used as a reference condition (Jref). It was assumed that judgments made in this condition would be closest to participants' "true judgment". First of all, separate regression analyses were done for the three presentation time conditions (17 ms, 33 ms and 500 ms). In each of these analyses, a different time condition was put in as dependent variable. For each analysis, reference judgment was characterized as a covariate.

The second part of the analysis consisted of a regression analysis as well. However, in this analysis the reference judgment (i.e. the 5000 ms condition) was the dependent variable. Visual simplicity and prototypicality were characterized as covariates in order to find their effect on the reference judgment.

### **Results**

Table 1 displays means and standard deviations for all of the experimental conditions. The results of the first set of linear regression analyses are shown in Figure 3. The green bars indicate the Beta-values (i.e. the regression coefficient) of the reference judgment on the three time conditions. The additional "error-bars" indicate 95% confidence intervals. This figure shows that the longer the presentation time, the closer it gets to the "true judgment". There is a greater difference in effect between 17 ms and 33 ms than that between 33 ms and 500 ms as well (see Table A2 [in Appendix A]).

Explained variance of Jref was also calculated for the three time conditions. In the 17 ms condition, 33% of the total variance was explained by Jref. For the 33 ms and 500 ms condition, 40% and 41% of the total variance was explained by Jref respectively. This means that in the 33 ms condition reference judgment accounts for 7% more variance than in the 17 ms condition. There is only a 1% increase of explained variance between the 33 ms and 500 ms condition.

Table 1

Means and standard deviations of perceived credibility for the experimental conditions.

Prototypicality	Visual simplicity	
	Low	High
	M (SD)	M (SD)
	17 ms	
Low	0.47 (0.25)	0.50 (0.24)
High	0.53 (0.24)	0.51 (0.28)
	33 ms	
Low	0.52 (0.23)	0.51 (0.24)
High	0.53 (0.24)	0.55 (0.28)
	500 ms	
Low	0.51 (0.27)	0.43 (0.26)
High	0.55 (0.27)	0.58 (0.27)
	Reference (5000 ms)	
Low	0.48 (0.26)	0.43 (0.26)
High	0.56 (0.26)	0.58 (0.27)

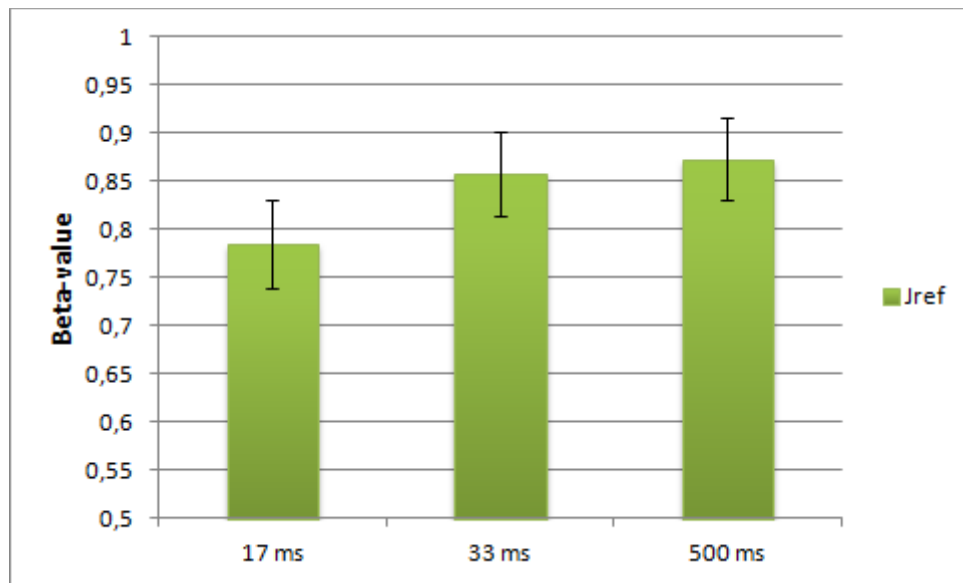


Fig. 3. Beta-values of the reference judgment (Jref) on the three presentation time conditions. Error bars indicate 95% confidence intervals.

Results from the regression analysis of VS and PT on Jref are shown in Figure 4. This figure shows that there is no significant effect of VS on Jref, but that there is effect of PT on the reference judgment (see Appendix B for the IBM SPSS syntax). For this analysis, explained variance of VS and PT was also calculated. It turned out that 11% of the variance was explained by VS and PT.

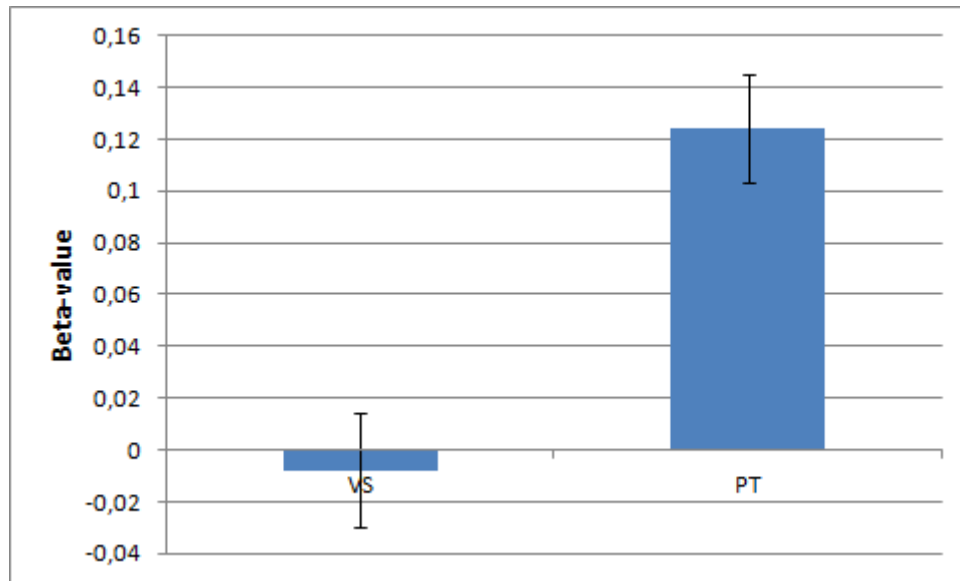


Fig. 4. Beta-values of VS and PT on the reference judgment (Jref). Error bars indicate 95% confidence intervals.

## Discussion

The aim of the present study was to broaden current knowledge of the effects of visual complexity (or visual simplicity) and prototypicality. Specifically, this study tried to uncover the effects of VC (or VS) and PT on the credibility of websites. The overall direction of results showed trends that could be helpful in learning about the influence of visual simplicity (or visual complexity) and prototypicality of websites on credibility judgments. The longer the presentation time of the stimuli, the closer the judgments resemble the “true judgment”. Results from the effects of VS and PT on the reference judgment showed that VS had a slightly negative effect, though this was not significant. PT however, did affect the reference judgment.

### *The influence of visual simplicity and prototypicality on credibility judgments*

In the model of aesthetic perception by Leder et al. (2004), presented in the present study, the effect of visual complexity is assumed to occur prior to the effect of prototypicality on aesthetic judgments. A study by Tuch, Presslauer et al. (2012), of which this study is an extension, indeed found that the effect of visual complexity is stable after 17 ms and the effect of prototypicality increases with longer presentation times. This study, on the contrary, found that the effect of visual simplicity (which is visual complexity reversed) on the reference judgment seemed slightly negative, whereas prototypicality seems to have a larger positive effect. These results do not fit very well with Leder et al.’s (2004) model. Visual simplicity

seems to play either a very minor role or no role at all in judging credibility at the 5000 ms condition. This could be because credibility is judged differently than aesthetics, for which Leder et al.'s model was intended. It could be that VS has more effect in the short presentation time conditions. It seems logical that people tend to use visual features when making judgments if the presentation time is short. In these presentation times there is no time yet to read sentences or analyze the content of the stimuli (Leder et al., 2004). This could also be explained as a case of heuristic processing in the short time conditions, whereas in the reference condition there is more time for people to process more systematically (Menchen-Trevino & Hargittai, 2011). However, in real-world situations websites are not shown for these short presentation times. This is the reason why the focus should be on the reference judgment (5000 ms). Interestingly, even in the reference condition, prototypicality influences the credibility judgment. A study by Robins and Holmes (2008) indeed shows a positive relationship between website aesthetics and credibility. In addition, Fogg et al. (2002) found that website design is of great importance to the credibility judgments people make of websites.

#### *Validity of credibility judgments*

Lucassen and Schraagen (2011) propose the 3S-model of information features and strategies. The 3 S's stand for Semantics, Surface and Source features. They also argue that people use these three features when they make judgments of credibility. For this study, the Surface part seems most important. As examples of surface information features, they name length, references, pictures and writing style. To link this to the present study, prototypicality and visual simplicity would probably fit in these surface features of information. Results showed that more than a tenth of the variance in the reference judgment was explained by VS and PT. This seems a substantial part of the differences in credibility judgments. When examining these findings, the question arises how valid these judgments of credibility actually are when they are influenced by visual features for a substantial part. Recall that credibility can also be described as believability (Tseng & Fogg, 1999). For people to believe and trust the information they are perceiving, they should not rely too much on visual features.

#### *Limitations*

There are at least four limitations in this study that should be noted. First, the websites that were used in the present study were company websites. Although people have a stable mental model of these websites (Roth et al., 2010), it remains unclear whether the effects of VS and

PT are also apparent in other kinds of websites. Further research should try to reveal more information on the effects of VS and PT on different websites. Second, the experiment was conducted under controlled conditions. For this reason, results from this study cannot be directly compared to real world settings. In real world situations, people will most likely not only look at the website's information, but they will probably also interact with the website. Despite this limitation, the results of this study have implications for first impressions of the credibility of websites. Third, the participants of the experiment were mainly young students of the University of Twente. There could be differences in the effects of VS and PT between age and education level, which are not accounted for in the present study. Other factors, such as the amount of years of experience with the internet, could also be of influence and are also not accounted for. Last, but certainly not least, visual simplicity and prototypicality are not yet fully understood. Both constructs consist of multiple subconstructs (e.g. shape, form, color), which are not controlled for in the present study. Future studies should look into these subconstructs to analyze and study them.

### *Conclusion*

To sum it up, visual features appear to influence first impressions of credibility of websites. These findings contribute to the body of knowledge of aesthetics and credibility of websites. In addition, the present study sheds light on the validity of credibility judgments. Future studies on the current topic are recommended in order to establish, for example, an "upper bound" for the reference judgment (or "true judgment"). Furthermore, this research has given rise to many questions in need of further investigation. For instance, after studying the effect of early visual features on aesthetics and credibility, the question arises if other user experience factors are influenced by these features as well. The possibility of contributing to change the way of looking at user experience is a very interesting proposition.

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## **Appendix A**

Table A1

Translation of the credibility items

Original (English) items	Translated (Dutch) items
Untrustworthy / Trustworthy	Onbetrouwbaar / Betrouwbaar
Unbelievable / Believable	Ongeloofwaardig / Geloofwaardig
Inaccurate / Accurate	Inaccuraat / Accuraat
Dishonest / Honest	Oneerlijk / Eerlijk
Does not report the whole story / Reports the whole story	Onvolledig / Volledig

Table A2

Parameters in the linear regression analyses

Parameter	Beta-value	95% confidence interval		p
		Lower	Upper	
Jref on				
17 ms judgment	.785	.739	.830	< .0005
33 ms judgment	.858	.813	.902	< .0005
500 ms judgment	.873	.830	.917	< .0005
VS on Jref	-.008	-.030	.014	.475
PT on Jref	.124	.103	.145	< .0005

## **Appendix B**

SPSS Syntax for the linear regression analyses:

DATASET ACTIVATE DataSet1.

SORT CASES BY Scale.

SPLIT FILE SEPARATE BY Scale.

\* Generalized Estimating Equations.

GENLIN J17 WITH Jref

/MODEL Jref INTERCEPT=NO

DISTRIBUTION=NORMAL LINK=IDENTITY

/CRITERIA SCALE=MLE PCONVERGE=1E-006(ABSOLUTE) SINGULAR=1E-012  
ANALYSISTYPE=3(WALD) CILEVEL=95

LIKELIHOOD=FULL

/REPEATED SUBJECT=Stimulus\*Subj\*AnchorLow SORT=YES

CORRTYPE=EXCHANGEABLE ADJUSTCORR=YES

COVB=ROBUST MAXITERATIONS=100 PCONVERGE=1e-006(ABSOLUTE)  
UPDATECORR=1

/MISSING CLASSMISSING=EXCLUDE

/PRINT CPS DESCRIPTIVES MODELINFO FIT SUMMARY SOLUTION

/SAVE XBPRED RESID.

\* Generalized Estimating Equations.

GENLIN J33 WITH Jref

/MODEL Jref INTERCEPT=NO

DISTRIBUTION=NORMAL LINK=IDENTITY

/CRITERIA SCALE=MLE PCONVERGE=1E-006(ABSOLUTE) SINGULAR=1E-012  
ANALYSISTYPE=3(WALD) CILEVEL=95

LIKELIHOOD=FULL

/REPEATED SUBJECT=Stimulus\*Subj\*AnchorLow SORT=YES

CORRTYPE=EXCHANGEABLE ADJUSTCORR=YES

```
COVB=ROBUST    MAXITERATIONS=100    PCONVERGE=1e-006(ABSOLUTE)
UPDATECORR=1
/MISSING CLASSMISSING=EXCLUDE
/PRINT CPS DESCRIPTIVES MODELINFO FIT SUMMARY SOLUTION
/SAVE XBPRED RESID.
```

\* Generalized Estimating Equations.

GENLIN J500 WITH Jref

```
/MODEL Jref INTERCEPT=NO
DISTRIBUTION=NORMAL LINK=IDENTITY
/CRITERIA SCALE=MLE PCONVERGE=1E-006(ABSOLUTE) SINGULAR=1E-012
ANALYSISTYPE=3(WALD) CILEVEL=95
LIKELIHOOD=FULL
/REPEATED          SUBJECT=Stimulus*Subj*AnchorLow          SORT=YES
CORRTYPE=EXCHANGEABLE ADJUSTCORR=YES
COVB=ROBUST    MAXITERATIONS=100    PCONVERGE=1e-006(ABSOLUTE)
UPDATECORR=1
/MISSING CLASSMISSING=EXCLUDE
/PRINT CPS DESCRIPTIVES MODELINFO FIT SUMMARY SOLUTION
/SAVE XBPRED RESID.
```

\* Generalized Estimating Equations.

GENLIN Jref WITH VS PT

```
/MODEL VS PT INTERCEPT=NO
DISTRIBUTION=NORMAL LINK=IDENTITY
/CRITERIA SCALE=MLE PCONVERGE=1E-006(ABSOLUTE) SINGULAR=1E-012
ANALYSISTYPE=3(WALD) CILEVEL=95
LIKELIHOOD=FULL
/REPEATED          SUBJECT=Stimulus*Subj*AnchorLow          SORT=YES
CORRTYPE=EXCHANGEABLE ADJUSTCORR=YES
COVB=ROBUST    MAXITERATIONS=100    PCONVERGE=1e-006(ABSOLUTE)
UPDATECORR=1
/MISSING CLASSMISSING=EXCLUDE
/PRINT CPS DESCRIPTIVES MODELINFO FIT SUMMARY SOLUTION.
```