The influence of first impressions on technology acceptance.

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Abstract English

This study is about the effect a first impression has on the final judgement. Visual complexity (VC) and prototypicality (PT) play a part in early visual processes. These processes occur before the stimulus is consciously perceived. In this case the study is about website. The final judgement is represented by technology acceptance which is defined in the Technology Acceptance Model (F. Davis, Bagozzi, & Warshaw, 1989a). TAM is concerned with the question of how do perceived ease of use and perceived usefulness lead to acceptance of a technology, in this case websites. The main question is do VC and PT have an influence on technology acceptance?

The answer is found by having people rate websites in 17ms, 50ms, 500ms and in a condition in which they could all the time they wanted. The results were unexpected as there was no effect of VC and PT on technology acceptance. What was apparent was that the early judgements correlated a lot with the final judgement. In most cases the judgement made in the 500ms condition correlated about 50% with the final judgement of the unlimited condition. This indicates that early visual processes in the brain do take place and form a first impression. Therefore the first impression is important but not in the way we anticipated when we started this research.

Abstract Dutch

In dit onderzoek wordt bekeken in welke mate de eerste indruk een effect heeft op het uiteindelijke oordeel. Visuele complexiteit (VC) en de mate waarin een website prototypisch is (PT) spelen een rol in vroege visuele verwerking. Deze processen vinden plaats voor de stimulus bewust wordt ervaren. In dit geval wordt er onderzoek gedaan naar websites. Het uiteindelijke oordeel wordt gerepresenteerd door het technologie acceptatie model (TAM) (F. D. Davis, Bagozzi, & Warshaw, 1989). TAM houdt zich bezig met de vraag hoe waargenomen bruikbaarheid en waargenomen nuttigheid leiden tot acceptatie van de technologie, in dit geval websites. De hoofdvraag is of VC en PT invloed hebben op technologie acceptatie. Een antwoord wordt gevonden door mensen een beoordeling te geven van websites in 17 milliseconden, 50ms, 500ms en een conditie waarin ze zoveel tijd mogen nemen als ze willen. De resultaten waren onverwacht omdat er geen effect werd gevonden van VC en PT op technologie acceptatie. Wat wel naar voren kwam was dat de vroege oordelen sterk correleerden met het uiteindelijke oordeel van de ongelimiteerde conditie. In de meeste gevallen correleerde het oordeel dat gemaakt werd in de 500ms conditie voor 50% met de resultaten van de ongelimiteerde conditie. Hierdoor lijkt het dat vroege visuele processen in het brein plaatsvinden en een eerste indruk vormen. Daarom is de eerste indruk belangrijk maar niet op de manier waarop we verwachtten toen we met het onderzoek begonnen.

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1. Introduction

A website developer might wonder why it is important to make a good first impression with his website. Having a good first impression wasn't the main focus of interactive computerized systems in the 1980's (Altaboli & Lin, 2011). In 1995 Kurosu and Kashimura discovered that apparent usability was strongly affected by apparent aesthetics. A program had to not only *be* usable but also *look* usable otherwise the consumer had no intention to start using it (Kurosu & Kashimura, 1995).

More users join the world wide web every day looking for information (Odlyzko, 2003). A consequence is that there are also more new websites every day (Moss, M.L. & Townsend, 2007). Creating a website has become relatively easy and because there are so many of these now, the consumer has a large number of options to choose from. Making a good first impression is very important because the user can easily ignore the website and move on to the next website if they don't like it. Furthermore, when a website makes a positive or negative first impression, then it could lead to a confirmation bias. This means that when a user has a negative first impression, they tend to judge the positive sides of the website lower or may disregard something positive altogether (Lindgaard, Fernandes, Dudek, & Brown, 2006).

The first thing a user sees when opening the website is the way the website looks. The lay-out and use of colours can make the user decide whether it's an aesthetically pleasing website or not. A judgement is formed on the website which causes the user to (dis)continue using it.

Being aesthetically pleasing is an important feature of many other products as well. Arousal and typicality (Blijlevens, Carbon, Mugge, & Schoormans, 2011), processing fluency (Reber, Schwarz, & Winkielman, 2004a), culture (Tractinsky, Box, & Sheva, 1997) and art (Leder, Belke, Oeberst, & Augustin, 2004a) are all related to aesthetics and its use in product development and sales.

There is also much research about the importance of aesthetics of websites ((Angeli, Sutcliffe, & Hartmann, 2006), (Altaboli & Lin, 2011), (Li & Yeh, 2010), (Tuch, Bargas-Avila, & Opwis, 2010)). Lindgaard et. al did a study about how fast people form a judgement based on the first impression of a website. They found that there is a role of cognitive affect; people

already like or dislike something before they're even consciously aware that they like/dislike it. They found that a stable judgement can be formed in the first 50ms of seeing a website. (Lindgaard et al., 2006). So aesthetic processing already begins at an early stage.

The outcome of an early aesthetic judgement plays a large role in the end result of whether someone will use the application or website. This technology acceptance is something which concerns the technology acceptance model (TAM). TAM is a model by Bagozzi (F. Davis et al., 1989a) which determines which variables contribute to technology acceptance of the intended user. It sets perceived usefulness and perceived ease of use as predictors for behavioural intention to use which leads to the acceptance of the technology. There are more variables which contribute to the end result of a user accepting or rejecting a website. In this study we will focus on the early visual processing of a website by a user. More specifically; the influence of prototypicality and visual complexity on technology acceptance will be researched.

2. Theoretical framework

2.1 Psychological model of aesthetic experience and judgements

In almost everything that we do, we use cognitive processing. Cognitive processes make use of two systems in our brain. The first system is the one which acts quickly, constantly, unconsciously, makes use of heuristics and takes no effort to use. This automated system is associated with feelings and originating impressions with no effort. A snap judgement you make when you see something or someone for the first time is an action by system 1. You do not feel that you have consciously made a judgement, it is more like something that happened to you (Kahneman, 2011a). The second system is the opposite: it's slow, takes effort to use, needs attention and concentration. This system is used in deliberate decisions and explicit beliefs. When you use this system to find a solution to a difficult multiplication for instance, you need to concentrate and turn your attention to what you know to solve this mathematical problem. This is the part you would describe if you would think of yourself. This is the system which makes moral choices, has beliefs en decides what to think and to do. It also has a controlling task of system 1 and intervenes when something is not right or should be done different.

This study focuses on the influence of the judgements system 1 (early visual processing) makes on the judgements of system 2 (deliberate cognitive processes). In this chapter will be explained which early visual and cognitive processes are important for this study.

Leder et al. presented a model of aesthetic processing(Leder et al., 2004a). They differentiated between aesthetic emotion and aesthetic judgements. An emotional reaction is important when people perceive art. In web design it's a by-product and it's more important to have an aesthetic judgement. In this study the focus is on the aesthetic judgement and whether this judgement leads to technology acceptance.

The model, found in figure 1, consists of 5 stages which people go through before giving an emotional reaction or giving an aesthetic judgement. They are: perceptual analysis, implicit memory integration, explicit classification, cognitive mastering and evaluation. Leder et al. researched why people are attracted by art. The model proposed that finding art aesthetically

pleasing involves a lot of determinants like complexity, symmetry, prototypicality, style, self-related interpretation, interest, domain specific expertise etc. (Leder et al., 2004a). Some of these determinants also apply to the aesthetics of websites.
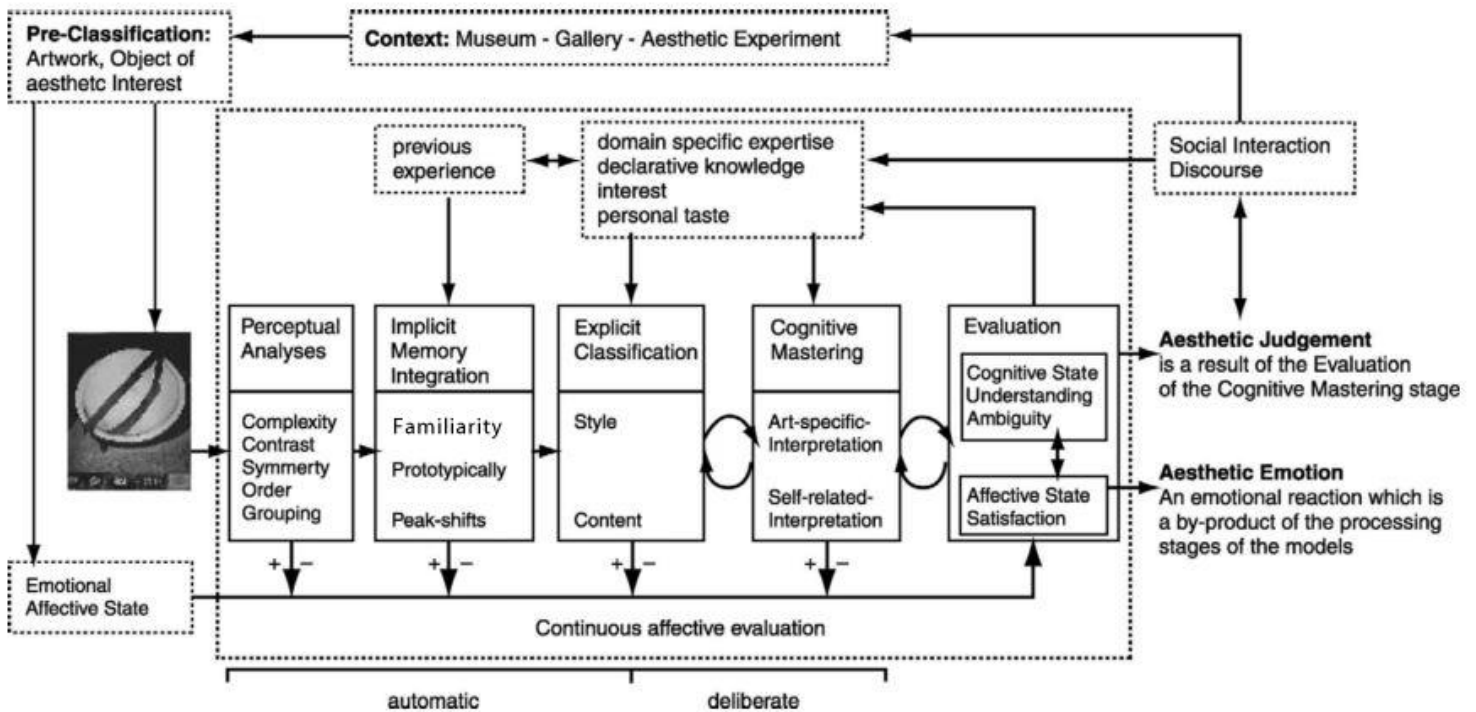

Figure 1. Model of aesthetic experience and judgement by Leder et al.

Perceptual analysis and implicit memory integration happen before people are consciously aware of it. In this study participants will have to make judgements in short periods of time (>500ms) so the first two stages are most important for this research. In the first stage, perceptual analysis, the basic features of the art are observed. Features like contrast, symmetry, grouping and visual complexity affect relatively simple judgements of aesthetic preference. A more positive judgement is achieved by using a clear contrast, symmetry and grouping in artwork. Ngo stated these features might help gain attention and build confidence in using computer systems (Ngo, Teo, & Byrne, 2003). Two other researches confirm these findings (Kurosu & Kashimura, 1995) & (Tractinsky et al., 1997)).

The second stage, implicit memory integration, is called implicit because at this point, the observer is not consciously aware of it. It consists of variables for which previous experience is needed (Nazareth & Schmettow, 2014). For example familiarity, also called the 'mere-exposure effect', means that if someone is familiar with something, they will develop a preference for it. This happens because familiarity creates an understanding and more fluent processing ((David Gefen, 2000a) & (Hekkert & Leder, 2008)). Prototypicality will be discussed later.

2.2 Fluency and familiarity

Fluency is an important factor in the early processing stages of stimuli. Fluent stimuli help the brain to process the stimulus without effort. Fluency processing is carried out by the two systems discussed earlier, mainly by the automatic system. A stimulus which is processed more easily by the brain is preferable because people are able to judge this stimulus fast and without effort when they see it. Stimuli which is not processed fluently causes cognitive strain and is rather avoided by people. Furthermore, something which is fluently processed is likely seen before and therefore no threat. And it may be seen as positive because it elicits error-free processing, it contributes greatly to recognizing the stimulus and it allows for easy access to the relevant information in the brain (Reber, Schwarz, & Winkielman, 2004b).

When a person is already busy with an effortful cognitive task, they tend to switch to system 1 and go for the straightforward answer or stereotype what they see; they make use of heuristics. Heuristics can be both useful and create difficulties. It is useful in the sense that an experienced person can make quick decisions based on past experiences and be right. A problem arises when the effortful system which should control the automatic process does not filter out important information. It is useful to be able to make fast decisions because this doesn't take as much effort and keeps us happy to be able to move through incoming perceptions with ease. But it also makes judgements and decisions so fast that people don't see relevant information and make mistakes as a result. It is called bias when people keep ignoring relevant information or making the same mistake (Kahneman, 2011a).

Familiarity is a variable which contributes to more fluent processing (Tuch, Presslaber, Stöcklin, Opwis, & Bargas-Avila, 2012). This happens because stimuli which have been seen

before are processed faster and become "easy" to be seen again ((Kahneman, 2011a) & (Reber et al., 2004a)). In stage 2 of the Leder model (implicit memory integration) the perceivers previous experiences help shape the judgement of aesthetics. A more familiar layout would have been seen before and therefore it's processed more easily (requiring less effort) so people will have a preference for this layout. People who have a perception of something will easily transfer this to a prediction of the future (Kahneman et al., 2002). So a preferable layout can make a good impression and will be used in a future judgement about the website. System 2 controls what the automatic processes do and intervenes when necessary. This would affirm the findings that if people like something they see, they will tend to judge it better. It can occur however that system 2 misses something of system 1, it does not have enough time to pay attention, it cannot put more effort into the judgement or has a bias for some information ((Nazareth & Schmettow, 2014) & (Kahneman, 2011a)).

Hassenzahl & Monk didn't find a direct correlation between beauty and usability. Instead they suggested that people use information that is available at that time to infer information that is not available. Inexperienced users will use beauty for this because it comes from visual information and is directly available (e.g. uses automated processes) ((Hassenzahl & Monk, 2010) & (Deniece Nazareth, Schmettow, & Schwabe, 2013)).

A relationship between familiarity, trust and technology acceptance seems to exist where familiarity makes people more trusting and therefore more willing to accept websites (David Gefen, 2000b). Another way familiarity contributes to trust is that it gives people a past with something which has not led to harm. So having a past with something contributes to trust and technology acceptance (D Gefen, Karahanna, & Straub, 2003). The mere exposure effect is the effect of familiarity; if a stimulus is presented multiple times people tend to develop a preference for it (Leder, Belke, Oeberst, & Augustin, 2004b). These factors all contribute to a preference of people for familiar stimuli and therefore quicker acceptation of these stimuli.

A recent study found that fluency has an influence on perceived beauty of websites. A website which takes factors into account which are important for good fluency will be accepted more positively on aesthetics (Deniece Nazareth et al., 2013). One of these factors is visual complexity.

2.3 Visual complexity and prototypicality

Tuch et. al wanted to know which factors influence such a fast judgement. They did a study about the effects of visual complexity (VC) and prototypicality (PT) on the judgement of the aesthetics of websites (Tuch et al., 2012). A visually complex website is one where there is a lot of visual information presented. Most studies found that moderately complex websites work best and complex websites are judged less beautiful. A more complex stimulus comes from asymmetry, much information at the same time, much variety and the structure (Xing & Manning, 2005). Factors which would reduce VC in a website would be a symmetrical layout because a person would only have to look at one half of the site to "know" how the other half looks (Tuch et al., 2010). Another factor would be not too much information at once to keep a clear layout.

A prototype is a mental representation which best represents that category. Prototypical stimuli are processed more fluently because they resemble an image a person has of what that stimulus should look like. An image which is just random is processed slower and with more effort that an image which contains a pattern (Winkielman, Halberstadt, Fazendeiro, & Catty, 2006). Prototypicality especially plays a role when stimuli have a short presentation time, people are uninterested and when little extra information can be extracted from the stimulus (Winkielman, Schwarz, Fazendeiro, Reber, & Erlbaum, 2003). 'Websites' is such a mental model, built through experience. When a person has seen a lot of websites, they get a mental representation or a scheme of what a website looks like. This scheme of a website is prototypical of the category 'websites'.

In the first experiment of Tuch et al. were websites tested by showing them to participants at a presentation time of 50, 500 and 1000 milliseconds (Tuch et al., 2012a). They expected perceptual analysis (needed to judge VC) to be faster than implicit memory integration (needed to judge PT). However, they didn't find this effect in their first experiment. They also didn't find difference between low visual complexity and medium visual complexity in this first experiment. In the second study they eliminated the variable medium VC and only used low and high VC. The websites were shown for a shorter period of time (17 and 33 milliseconds). And now they found that visual complexity has a more pronounced effect before

prototypicality does. Other findings were that if VC was high, the websites are judged lower and if PT was high, the websites are judged better. It seems the phase of perceptual analysis comes before implicit memory integration (Leder et al., 2004b). Complexity, contrast and symmetry are quickly detected and are processed fluently. Familiarity and prototypicality need more cognitive processes because previous experiences need to be integrated to complete these processes. Some of these processes are done in 17ms but at 33ms this "delay" has disappeared (Tuch et al., 2012a). This research will study this also and be able to confirm or disconfirm these findings.

2.4 Technology acceptance model

Lindgaard et. al conclude in their study that there should be more research on how much weight to give the first impression of a website (Lindgaard et al., 2006). This is something which concerns the Technology Acceptance Model. TAM asks one important question: will the target group actually use this technology? (F. D. Davis et al., 1989) The original model answered this question in two ways: does the user perceive the technology as useful and how does this person perceive the ease of use of the technology? Both are good indicators for predicting the actual use of the technology (F. D. Davis et al., 1989).

TAM started as an adaptation of the Theory of Reasoned Action (TRA), only TAM is specifically intended for acceptance of computer systems. The TRA was developed to predict behaviour by studying determinants of behaviour (Hunt & Gross, 2009). The TRA is used as a basis for explaining the causal relation between perceived ease of use and perceived usefulness. Perceived usefulness is defined as: "the user believes that using this system will improve his or her performance in the intended context". Perceived ease of use is defined as: "the belief of the user that the system takes no effort to use".

Figure 2 shows a scheme of the original TAM. Davis, Bagozzi and Warsaw believed that a positive attitude towards the system comes from the idea that the user believes this system will make their performance easier and better. When people have positive feelings towards something they will intent to use it because this leads to extrinsic rewards. The positive attitude leads to the 'behavioural intention to use' which is a good predictor for actual use (F. D. Davis et al., 1989; Venkatesh & Davis, 2000).
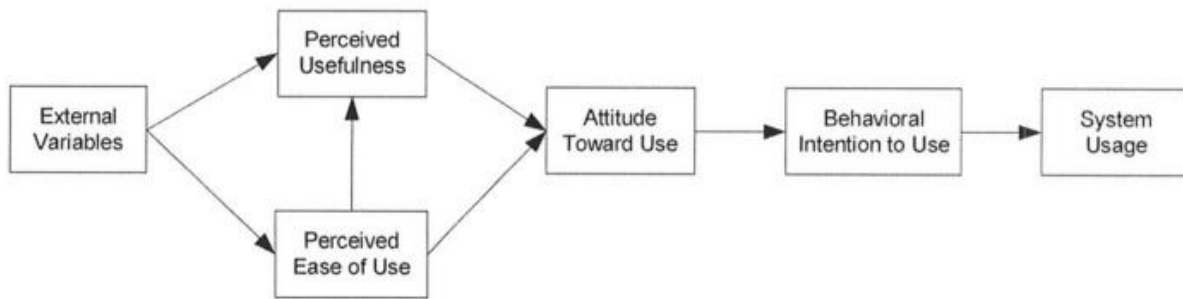
Figure 2. The original technology acceptance model (TAM).

In 2000 Venkatesh and Davis made a theoretical extension of TAM, called TAM2 (Venkatesh & Davis, 2000). TAM2 discusses the subjective norm, voluntariness and image as social factors which can influence a user's decision to either use or reject a system. They found that subjective norm did influence perceived usefulness significantly. And they found that the subjective norm had a stronger, significant effect than perceived usefulness and perceived ease of use when the use of systems is mandatory (e.g. at work) but not for voluntary use. Another finding was that with experience over time, users also relied less on social information. This was not the case for perceived usefulness (Venkatesh & Davis, 2000).

The study of Chen, Gillenson & Sherrell confirmed the use of TAM for the business-to-consumer aspect of electronic commerce websites (Chen, Gillenson, & Sherrell, 2002). Gefen, Karahanna & Straub also confirmed this use in combination with trust in an electronic commerce website (Gefen, Karahanna, & Straub, 2003). They combined usefulness, ease of use and trust variables and found that trust in a website is also a strong predictor for technology acceptance. People who trust a website are more likely to accept the website. Another study also found a positive correlation of trust with aesthetics (Schmettow & Kuurstra, 2013).

Hsu & Lu did a study about online games with TAM, they extended TAM to include social influence and flow experience (Hsu & Lu, 2003). Flow is the holistic experience people feel when acting with total involvement (Csikszentmihalyi, 1992). One of the operational definitions of flow experience is ease of use.

In 2004 Ma & Liu did a meta-study about the results of TAM. They confirmed that perceived usefulness is critical in user technology acceptance (Ma & Liu, 2004). Their second

confirmation is that perceived ease of use has a strong impact on the perceived usefulness so it's very important to design an easy to use system to increase the perceived usefulness. Their findings on the effect of perceived ease of use on technology acceptance are inconclusive. In websites which involve a questionnaire, the effect was found but for websites which include online shopping this effect was not found. They found that individual and task characteristics might influence perceived ease of use relating to technology acceptance and recommended that this be further investigated in the future.

In 2007, Ahn, Ryu & Han found that information, service, and system quality all had a positive effect on users beliefs in acceptance of online retailing websites (Ahn, Ryu, & Han, 2007). They determined that user friendliness was an aspect of perceived ease of use. When a stimulus seems easy to use people know they do not have to put much cognitive effort in to understand it. So ease of use contributes to a more fluent processing because it indicates that the target is successfully recognized and interpreted (Winkielman et al., 2003). Gefen and Karahanna found the same effect of trust on the determinant of technology acceptance of commercial websites (David Gefen, Karahanna, & Straub, 2003).

Efficiency helps technology acceptance because it enables fluent processes which contribute to acceptance. An interface with a good screen design is more likely to be processed automatically so it will be more efficient (Salimun, 2013).

These variables all contribute to technology acceptance which is why items concerning these variables were used in this research. It is interesting to know to what extend these variables and their associated cognitive processes play a role in technology acceptance.

2.5 Research question

This research will resemble a study done by Tuch et al. which is mentioned above (Tuch, Presslaber, Stöcklin, Opwis, & Bargas-Avila, 2012). Tuch et al. researched the effect of prototypicality (PT) and visual complexity (VC) on the judgement of aesthetics of websites. We replicate this research to determine whether PT and VC have influence on TAM. Perceived usefulness, perceived ease of use and perceived technology acceptance will be measured. These determinants are all "perceived" because we will not actually test these items by interaction of the participants with the website. The participants will only make a judgement of

the websites based on screenshots of the websites. The hypotheses will be answered with the results derived from their first impressions.

Hypotheses

This study aims to explore the possibility that the PT and VC of websites have influence on the determinants of TAM. So a visually simple website should lead to a better judgement of perceived ease of use. And such a website should also imply that this website will be perceived as more useful. These determinants should then lead to more people choosing to use this website. The same should be true for a prototypical website.

1. A positive effect of low VC on technology acceptance at 17ms is also found at 50ms, 500ms and the unlimited condition.
2. A positive effect of high PT on technology acceptance at 17ms is also found at 50ms, 500ms and the unlimited condition.

In accordance with the study of Tuch et. al (2012), it is expected that VC will have a stronger effect on the 17ms condition than PT but both will have an equal effect in longer conditions.

3. VC will have a stronger effect in the 17ms condition than PT but not in the 50ms, 500ms and unlimited conditions.

Another prediction is to compare the timed conditions with the unlimited condition in which the unlimited condition is a reference group. In this situation there will probably be stronger judgements with every subsequent condition.

4. To what the extent does cognitive processing play a role at 17ms, 50ms, 500ms and in the unlimited condition, depending on condition and scale?

3. Method

3.1 Design

This study closely resembles a study done by Tuch et al. (2012). The study consists of websites which are already judged on VC and PT. These websites are shown in four conditions (17ms, 50ms, 500ms and the unlimited condition) and rated by the same participant. The objective is to gather data which will show to what extend PT and VC have influence on TAM and which cognitive processes play a role in this. There are a few changes from the study of Tuch. In this experiment there were only within-subject independent variables (i.e. repeated measures design). They were prototypicality (low and high), visual complexity (low and high) and condition (17ms, 50ms, 500ms and unlimited). We replaced the 5000ms condition of Tuch with an unlimited condition to ascertain that participants had enough time to make a true judgement. Perceived technology acceptance is the dependent variable. This study

3.2 Participants

There were n=40 participants (28 female and 12 male) in this study. The requirements were that the participants had either Dutch or German as their native language. The native language was Dutch for 17 participants and German for 23 participants. All participants read and signed a consent form. The participants consisted mostly of students of the University of Twente and some acquaintances of the researcher. 34 participants were students and the rest completed an education and are working. Students of behavioural sciences could receive 0,75 credit for participating. Ages varied between 19 and 57 years old with a mean age of 26 years (SD=8.82). The sample contained 4 people who had experience with web design, the rest had little to no experience with this.

3.3 Materials

For this experiment a laptop with an external mouse and display were used. The display was a 22" LCD monitor with a 5ms switch time (the LG E2210). The resolution was set to 1680x1050. An LCD screen was chosen because it has less display persistence than a CRT screen (Lagroix, Yanko, & Spalek, 2012). For the experiment psychopy was used (Psychopy standalone version 1.79.01), a python-based program which is used for experiments with short presentation times.

3.4 Stimuli selection

The same stimuli are used for study as the study done by Tuch et al. (Tuch et al., 2012). They started by using 464 websites of which they excluded websites with advertisements and a language different than English or German. Then they had 267 people rate these websites on prototypicality and visual complexity. In the end this led to a pool of 120 websites. In this study, the medium level of visual complexity was excluded. Therefore in this study, 66 websites were rated by the participants.

3.5 Rating

The rating of the websites was done through visual analogue rating scales. The participants had to use an analogue slider to judge items related to technology acceptance. The items were: this website seems useful, user friendly, efficient, trustworthy and to have good quality and if the participant would use the website. The items were taken of different studies and all contribute to technology acceptance ((David Gefen et al., 2003), (Lavie & Tractinsky, 2004) and (Ahn et al., 2007), (Salimun, 2013)). The items were translated in Dutch and German (see appendix A for the list of items and its translations). Items were chosen on compatibility with this study. Many items require an experiment were usability is measured by participants interacting with a website. In this study judgements are made on visual information alone so items which required interaction were not chosen. The original TAM used perceived ease of use, perceived usefulness and technology acceptance as variables and are not proven wrong to this day so they were included. Another item was perceived trust because this was proved to contribute to technology acceptance (David Gefen et al., 2003; David Gefen, 2000a; Lindgaard, Dudek, Sen, Sumegi, & Noonan, 2011). Website quality and efficiency are also items which contribute to technology acceptance and were therefore chosen (Ahn et al., 2007; Wetterneck, Carayon, Sobande, & Schoofs, 2005; Lavie & Tractinsky, 2004).

The experiment was done together with another study on the influence of VC and PT on the User Experience Questionnaire (UQE). Participants rated the websites on a scale of TAM or of UQE. There were twelve scales in total, 6 for TAM and 6 for UQE.

3.6 Procedure

All the experiments were carried out a quiet room at the University of Twente. The room contained only a table, chair and the laptop and was closed off so the participants were alone and not disturbed. The participants were seated behind a computer on which the experiment took place. They were asked to sign a consent form and demographics were asked like their age, gender, study, number of years they used the internet and number of years of experience in web design were asked. The researchers explained the procedure and further instructions were shown on the screen. After that there was a practice phase to familiarize the participant with the experiment after which the actual experiment began. After each website was shown the participants made a judgement on a visual analogue scale. They judged by a statement that was shown and rated whether they completely disagreed to completely agreed. Each block consisted of 76 websites which they were shown in random order. There were four blocks and every block consisted of a different presentation time (first 17ms, then 50ms, 500ms and last the unlimited condition). Between every block was a 30 second break and the experiment lasted for half an hour. There is a phenomena called an after-image which enables a person to see a stimulus for 250 milliseconds after it has disappeared ((Goldstein, 2013). To counteract this persistence of vision, a mask was added after each stimulus was shown. An image of the flow of the experiment is found in figure 3.

| Fixation cross | → | Website | → | Mask | → | Scale |

Figure 3 Flow of the experiment.

3.7 Analysis

To answer the research questions about whether VC and PT have an effect on technology acceptance, a regression analysis was carried out. This was done by using IBM SPSS 21.0. In SPSS the analysis was carried out by using the linear mixed models command. This model was chosen because this research makes use of repeated measures within a subject. The dependent variable was the response of the participant. VC is known to affect judgements negatively so it

was converted to visual simplicity (VS) to interpret the results more easily (Schmettow & Boom, 2013).

In the first analysis the variable 'unlimited' was made the independent variable because this is the condition in which judgements were made which are closest to the true judgement. A three-way interaction effect was conducted between scale*condition*unlimited_response to determine the interaction effect between the first three conditions and the unlimited condition. This was done to know more about the extent to which there is cognitive processing at various presentation times depending on condition and scale. This analysis gives results with which the fourth hypothesis can be answered.

Next there was a regression analyses to determine how much effect PT and VC have on the judgements. This was also done by the mixed models command only now the unlimited variable was part of the time conditions again. This analysis produces results to answer the first three hypotheses.

4. Results

In total the 40 participants made 10560 judgements about the 66 websites. There were six scales which had to be judged, all related to technology acceptance. All participants have experience with using websites, the mean was 11,38 (SD=3,31), the least experience was 7 years and the most was 19 years.

The results of regression analysis of the effect of VC and PT on the judgements was unexpected. There was no significant effect of VS (F(1;7910,411)= 0,057) p=0,811) or PT (F(1;7914,068)= 0,996) p=0,318) so there weren't any further analyses with these results (see appendix B for the SPSS outcome and appendix C for the syntax).

In table 1 are the values for the VS and PT interaction with the condition. Only the interaction between the fourth (unlimited) condition and prototypicality was significant but its estimate was close to zero (-0,05) that this did not tell anything about the first impression and the research questions. Table 2 shows the same values for VS and PT interaction with the scales. A significant interaction effect was only found between scale 10 (perceived usefulness) and prototypicality.

The results of the unlimited condition separated from the timed conditions was different. In table 3 are the correlations in a table and in figure 2 are the results of this mixed effects model in a graph.

Estimates of Fixed Effects[a]

Parameter	Estimate	Sig.	95% Confidence Interval	
			Lower Bound	Upper Bound
17ms * VS	,016	,391	-,021	,055
50ms * VS	-,009	,634	-,047	,029
500ms * VS	-,014	,476	-,052	,024
Unlimited * VS	-,017	,373	-,056	,021
17ms * PT	,023	,224	-,014	,062
50ms * PT	-,026	,170	-,065	,011
500ms * PT	-,037	,055	-,076	,000
Unlimited * PT	-,050	,010	-,089	-,012

Table 1 SPSS outcome of interaction effect of condition and VS and PT.

Estimates of Fixed Effects[a]

Parameter	Estimate	Sig.	95% Confidence Interval	
			Lower Bound	Upper Bound
Perceived efficiency * VS	-,032	,508	-,127	,063
Perceived ease of use * VS	,005	,908	-,085	,095
Perceived quality * VS	-,036	,414	-,122	,050
Perceived trustworthiness * VS	-,015	,728	-,104	,072
Perceived usefulness * VS	-,039	,404	-,130	,052
Technology acceptance * VS	,030	,504	-,058	,118
Perceived efficiency * PT	-,082	,091	-,177	,013
Perceived ease of use * PT	-,020	,692	-,119	,079
Perceived quality * PT	-,033	,482	-,126	,059
Perceived trustworthiness * PT	,038	,411	-,053	,131
Perceived usefulness * PT	-,148	,001	-,237	-,059
Technology acceptance * PT	-,033	,445	-,119	,052

Table 2 SPSS outcome of interaction effect of scales on VS and PT (continued on next page).

Estimates of Fixed Effects[a]

| Parameter	Estimate	Sig.	95% Confidence Interval	
			Lower Bound	Upper Bound
Perceived efficiency * 17ms * Unlimited	.246	.001	.099	.392
Perceived efficiency * 50ms * Unlimited	.250	.001	.104	.396
Perceived efficiency * 500ms * Unlimited	.327	.000	.181	.473
Perceived ease of use * 17ms * Unlimited	.009	.909	-.143	.161
Perceived ease of use * 50ms * Unlimited	.219	.005	.067	.371
Perceived ease of use * 500ms * Unlimited	.389	.000	.237	.541
Perceived quality * 17ms * Unlimited	.204	.008	.053	.355
Perceived quality * 50ms * Unlimited	.401	.000	.250	.552
Perceived quality * 500ms * Unlimited	.612	.000	.461	.763
Perceived trustworthiness * 17ms * Unlimited	.055	.475	-.095	.205
Perceived trustworthiness * 50ms * Unlimited	.321	.000	.171	.471
Perceived trustworthiness * 500ms * Unlimited	.547	.000	.397	.698
Perceived usefulness * 17ms * Unlimited	.096	.206	-.053	.245
Perceived usefulness * 50ms * Unlimited	.184	.016	.034	.333
Perceived usefulness * 500ms * Unlimited	.534	.000	.384	.683
Technology acceptance * 17ms * Unlimited	.167	.012	.037	.297
Technology acceptance * 50ms * Unlimited	.289	.000	.159	.419
Technology acceptance * 500ms * Unlimited	.404	.000	.274	.533

a. Dependent Variable: zResponse.

Table 3 SPSS outcome of correlations between scale, the first three conditions and the unlimited condition.

Most scale items have a stronger judgement when the participants are given more time to look at a website. The correlation strength varies between 0,3 and 0,6. Except for perceived efficiency, the results show that the longer someone watches a website, the stronger his/her judgement correlates with his/her judgement in the unlimited condition. In some cases there is already a judgement formed at 17ms (e.g. perceived efficiency, perceived quality, perceived usefulness and technology acceptance). And this judgement only becomes stronger in de next timed conditions in reference to the unlimited condition.

Perceived efficiency is a deviation from the other results. The estimate doesn't show a climbing line like the other scales but stays the same over the first two conditions (0,246 and 0,250 respectively) and rises only slightly in the third condition (0,327). The first condition doesn't deviate compared to the other scales; technology acceptance and perceived quality also have high results. The same argument could be made for the second condition because other conditions have similar results (perceived ease of use and perceived usefulness). The third condition is the lowest of all (0,327) but still there's not a large difference with, for example, perceived ease of use (0,389). Although the differences aren't large, difference for the missing upwards slope is. This indicates that the judgement on perceived efficiency doesn't correlate more strongly with the unlimited condition.
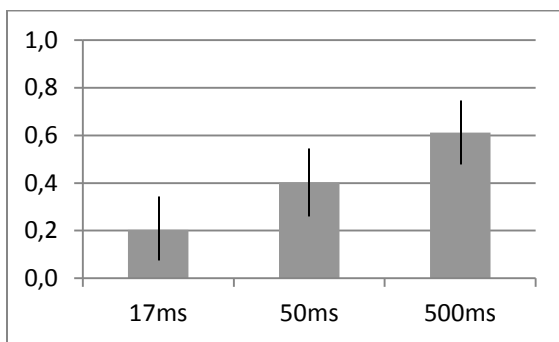
Perceived usefulness is correlated to the final judgement but only in the third condition does this become very clear. The first conditions (0,096 and 0,184) do correlate a small amount but the last condition shows a much stronger correlation (0,534).
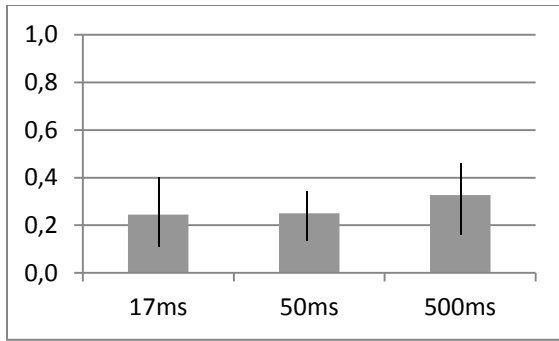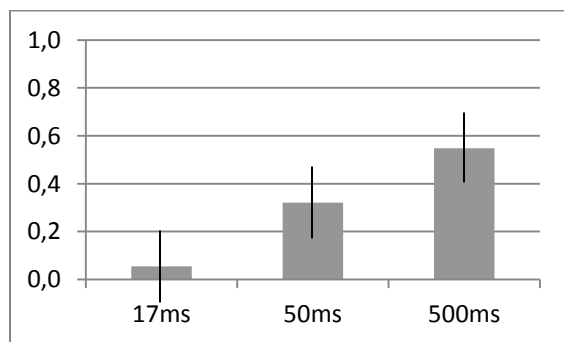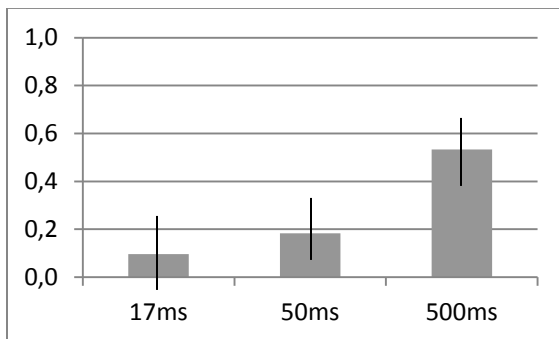
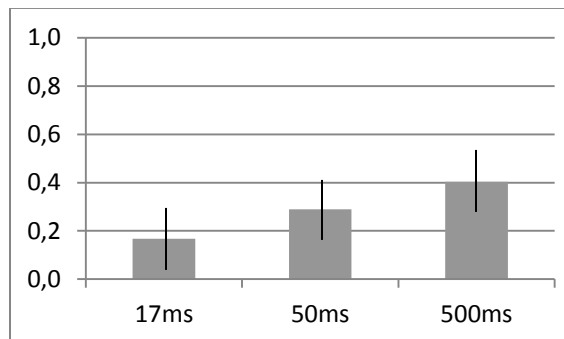4.1 Perceived efficiency
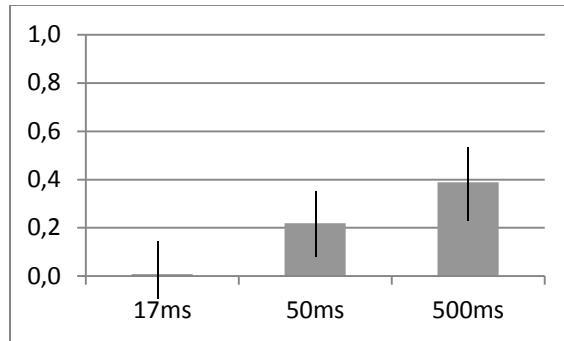
4.2 Perceived ease of use

4.3 Perceived quality

4.4 Perceived trustworthiness

4.5 Perceived usefulness

4.6 Technology acceptance

Figure 4 Results of timed conditions on the unlimited condition.

5. Discussion

5.1 Discussion

The results of the regression analysis, as seen in figure 4, vary between 0,327 and 0,612 in the 500ms condition. This means that for example the judgement on perceived quality already correlates 0,612 with the final judgement, just based on visual exposure in the first half of a second. Lindgaard et al did a study about this in which they found that a stable judgement is made in 500 milliseconds in their second experiment. In their next study they introduced a condition of 50 milliseconds to determine whether a mere exposure effect takes place. They concluded this effect wanes before 50ms which allows people to see more design characteristics with every exposure. The main result from this study is captured in their title: "Attention web designers, you have 50ms to make a good first impression!". This study reaffirms Lindgaards findings; the 50ms condition is a good predictor for the final judgement and the 500ms condition is even better. The reason Lindgaard did find strongly significant results at 50ms could be because of the absence of masks. They didn't use a mask after each display of a website in the experiment. This could lead to after images of up to 250 milliseconds which people could use for their judgements (Goldstein, 2013). Therefore it could be that 50 milliseconds is actually 300 milliseconds of viewing. This is a lot closer to the 500ms at which this study found more significant results. So it would seem Lindgaard found more significant results at a shorter presentation time but probably found significant results at 300 milliseconds.

Perceived efficiency deviates from the other scales which can have multiple causes. All results show a significant correlation with the final judgement (p=0,001, p=0,001 and p<0,000). Perceived efficiency could be hard to process based on visual processing alone. It needs additional time for system 2 to take a look at it to get a stronger judgement. This means that more cognitive processes like concentration, effort and attention are needed to form a stronger final judgement. These processes take more time and need more than half a second to do this.

Perceived ease of use is a scale which is hard to judge in 17ms. People need more time to make a judgement. And even then it doesn't correlate as strongly as some of the other scales. Perceived ease of use could also be a scale which is not a great predictor of technology acceptance based on early visual processing alone. It is one of the scales for which the

observations of the first condition are not significant at the 0.05 level (p=0,909). This corroborates the finding that people don't make a predictive judgement at this level. The end judgement is stronger (0,388) but not as strong as some of the other correlations that were found. It might need a usability test in which the participants actually interact with the website to get a stronger judgement. These results don't mean that perceived ease of use is altogether useless because still 1/3 of the final judgement is made in that first half of a second. It rather indicates that there are more cognitive processes needed to get to the final judgement. Another explanation for these lower correlations could be that every participant is experienced with using websites. Experience weakens perceived ease of use as a predictive factor and after a while will only indirectly influence perceived usefulness (F. Davis, Bagozzi, & Warshaw, 1989b). This may play a part in these findings which do not correlate more than 0,4 with the end judgement.

Perceived quality seems to be a good indicator of technology acceptance. It shows a strong correlation with the final judgement of the website. It seems that a website which conveys a good quality is judged better based on the first impression. Perceived trustworthiness also has a strong judgement of the first impression in 500ms. However it is not significant in the first condition (p=0,475). This indicates people also have difficulty making a good judgement for perceived trustworthiness in the first 17 milliseconds. The judgements on the other two conditions are very significant (both p<0.000) and are stronger predictors for the final judgement.

Technology acceptance shows the same rising line as perceived quality and perceived trustworthiness and all the conditions are significant at the 0,05 level.

The judgement on perceived usefulness is mainly formed between 50ms and 500ms. It seems that there is less early visual processing going on. The validity of such an early judgement can therefore not be ensured. In the first 17ms there is little correlation with the final judgement and in the case of perceived usefulness it also is not significant at the 0.05 significance level (p=0,206). At such a short presentation time there is not enough time for someone to make a judgement which reflects the final judgement. Early processes like perceptual analysis can't be completed at this speed. Still the judgement at 500ms correlates

over 50% with the final judgement. So it is also a strong predictor of technology acceptance, only after more time is given to process the website.

All scales confirm the fourth hypothesis of having a more or less stronger correlation in each subsequent condition. This means that for every scale there is a part of the final judgement made in the first half of a second. This indicates that a lot of visual information and previous experience is already processed at a very early stage, which impacts the judgement made in the unlimited condition. This is a result which stresses the importance of a good first impression.

Tuch et al. (2012) found that VS and PT are important predictors for aesthetic perception of websites in the context of first impressions. Considering the correlation between aesthetics (external variables) on perceived usefulness and perceived ease of use (predictors of technology acceptance) we would expect the same results (Leder et al., 2004b). Leder states that there are aesthetic variables which influence the aesthetic judgement, among others; VC and PT. Because this study didn't find these correlations it could be that either VC and PT aren't good predictors of aesthetic judgement or this study found incorrect results. This study could be wrong because the model of Leder is not made specifically for web design but for art. Another cause could be that the emotions which come with seeing a website have influence on the judgement, which is also suggested by Leder. This study didn't take emotions in account. An argument can be made that the content of the website causes an emotional reaction which influences the judgement. Some participants made remarks that there were a lot of websites about cars and that this may influence their judgement if they strongly like or dislike cars. And although the participants were explicitly told to try and make an intuitive judgement, some had a hard time trying to do this in the 17ms condition. Some people became a little frustrated because they couldn't see the website. This may have had an (subconscious) influence on the way they judged a website.

A difference between this study and the one by Tuch was that Tuch did not have any participants who had experience in web design and this study had some participants who did. Some participants have had some lessons in web design and others use web design regularly for work etc. 7 participants had little experience and 4 had much experience in web design. This

might have caused the differences between both studies. As described earlier, Hassenzahl & Monk (2010) suggested that the inexperienced user uses beauty to judge usability if they don't have the right information. Because this study had participants with experience it might mean that these participants made their judgements in another way than inexperienced participants. Experience can lead to great intuitions or it can lead to biases and overconfidence (Kahneman & Klein, 2009). Repeated experiences provides more fluent processing (Kahneman, 2011b). Experienced participants are able to use system 1 more because of their experiences. This is because when behaviour is practiced it becomes automated; there is a shift in use of system 2 to system 1. Most judgements are then made by system 1 which causes the pleasant feeling of fluent processing. This pleasant feeling can lead to biases because people with experience will not use system 2 to check what system 1 does and therefore fail to analyse a stimulus better. This experiment asked participants to make a judgement as intuitively as possible. So "experts" tried to use system 2 as little as possible, allowing bias to influence their judgement at 17ms. The longer a participant has the chance to observe a website, the more help they get from system 2. In the unlimited condition they can take all the time they need to make a final judgement.

The question rises if participants really did take their time to give a judgement in the unlimited condition. To find this out it would require to measure reaction times. This study didn't take reaction times in account so there's no certainty about how long participants took to make a judgement in the unlimited condition. Presumably they looked longer at it than in the previous conditions because then they would be able to use more cognitive processes. When people have seconds instead of milliseconds they will be able to use deeper cognitive processing to make a judgement. They can use slow, deliberate processes to analyse the website and make a more measured judgement. This experiment didn't make use of an usability test where participants interact with the website so only visual information was available in the conditions to judge the scales. Because these websites were judged on visual information alone, they probably didn't take more than a few seconds to make their judgements. What would happen if they did take more time should be an interesting topic for future research. This could be set up by letting participants make a judgement on a website and

measure their reaction times or make sure they look at a website for at least a few seconds before they can answer. If the reaction times are measured then the reaction times should be longer in the unlimited condition than any of the timed condition. This is because automated processing is fast and analytical thinking is slow and should take longer. The results should reflect a correlation between reaction time and type of condition (timed or unlimited) to determine if this is indeed the case.

5.2 Limitations and future research.

This study has a few limitations like the use of only business websites. It may have an effect on participants in a different way than commercial, social or other websites. It was noticed by some participants because they made remarks about the amount of websites about cars. Future research should also include other kinds of websites to see if the same results apply to them.

Future research should be able to confirm the findings of this experiment concerning the influence of VC and PT on the variables of TAM. Research can then focus on why this effect is not found. The recommendation of this study is to use an usability test and see if this will produce different results.

Another factor which should be studied in the future is what role experience with web design plays in the judgement of websites. Tuch et al. did not include any of these participants but this study did. This might play a role in the different outcomes of these studies.

A meta study by Hassenzahl & Monk found that there is no direct relation between beauty and usability (Hassenzahl & Monk, 2010). They stated that this is mediated by 'goodness'. Seeing as this study didn't find a relation between aspect of beauty and usability, it might be worth to take a look at goodness to see if it has any influence on these aspects.

In the first half of a second someone makes a judgement which is already half fixed. What does it take to become a whole final judgement? There are many other variables which contribute to a judgement. Early cognitive processes alone account for about half of the judgement so future research should examine which variables play a role in the other half of the judgement.

6.   Conclusion

In contrast to what was expected, visual complexity and prototypicality of websites are not good predictors for the technology acceptance model. The scales that are used to measure TAM are not influenced by VS and PT. Perceived ease of use, perceived usefulness and technology acceptance, the three main factors in TAM, do not appear to be influenced by symmetry, colour, lay-out and other factors related to VS and PT. An explanation could be that the variables of TAM need to be judged based on a usability test and not on a test measuring early cognitive processes.

What we did find is a correlation between the early judgements of the first three, timed conditions and the last, unlimited condition. Three scales can have a significant, predictive judgement in 17 milliseconds. And all the scales have a significant, predictive judgement at 50 milliseconds which strengthens when the website is shown for 500 milliseconds. These findings are in accordance with a study done by Lindgaard et al. (Lindgaard et al., 2006). The surprising results of this study left open some questions which can be answered by future research.

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Appendix A

Items used in the experiment and their translation.

Language	Item	Answer
English		
	This website seems useful	Completely disagree/agree
	This website seems user friendly	Completely disagree/agree
	I would use this website	Completely disagree/agree
	This website seems efficient	Completely disagree/agree
	This website seems to have a good quality	Completely disagree/agree
	This website seems trustworthy	Completely disagree/agree
Dutch		
	Deze website lijkt me nuttig	Helemaal mee oneens/eens
	Deze website lijkt me gebruiksvriendelijk	Helemaal mee oneens/eens
	Ik zou deze website gebruiken	Helemaal mee oneens/eens
	Deze website lijkt efficiënt	Helemaal mee oneens/eens
	Deze website lijkt een goede kwaliteit te hebben	Helemaal mee oneens/eens
	Deze website lijkt betrouwbaar	Helemaal mee oneens/eens
German		
	Diese website scheint nützlich	Ich stimme nicht zu/zu
	Diese website scheint benutzerfreundlich	Ich stimme nicht zu/zu
	Ich würde diese website verwenden	Ich stimme nicht zu/zu
	Diese website scheint effizient	Ich stimme nicht zu/zu
	Diese website scheint von guter qualität zu sein	Ich stimme nicht zu/zu
	Diese website scheint vertrauenswürdig	Ich stimme nicht zu/zu

Appendix B

SPSS outcome main effect of VS and PT.

Type III Tests of Fixed Effects

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	20.997	.052	.822
zVS	1	7910.411	.057	.811
zPT	1	7914.068	.996	.318

a Dependent Variable: zResponse.

Appendix C

SPSS syntax of the linear mixed model for scale*condition*unlimited.

```
GET
  STATA FILE='W:\BA Aesthetics 2014\Data\Tuch2w.dta'.
DATASET NAME DataSet1 WINDOW=FRONT.
MIXED zResponse BY Item Scale Condition WITH zRespUnlim
  /CRITERIA=CIN(95) MXITER(100) MXSTEP(10) SCORING(1)
SINGULAR(0.000000000001) HCONVERGE(0, ABSOLUTE) LCONVERGE(0, ABSOLUTE)
PCONVERGE(0.000001, ABSOLUTE)
  /FIXED=Scale*Condition*zRespUnlim | SSTYPE(3)
  /METHOD=REML
  /PRINT=SOLUTION
  /RANDOM=Item | COVTYPE(VC)
  /RANDOM=Scale | COVTYPE(VC)
  /RANDOM=Condition | COVTYPE(VC).
```

SPSS syntax of the linear mixed model for scale*VS and scale*PT.

```
GET
  STATA FILE='W:\BA Aesthetics 2014\Data\Tuch2.dta'.
DATASET NAME DataSet1 WINDOW=FRONT.
MIXED zResponse BY Scale WITH zVS zPT
  /CRITERIA=CIN(95) MXITER(100) MXSTEP(10) SCORING(1)
SINGULAR(0.000000000001) HCONVERGE(0, ABSOLUTE) LCONVERGE(0, ABSOLUTE)
PCONVERGE(0.000001, ABSOLUTE)
  /FIXED=Scale*zVS Scale*zPT | SSTYPE(3)
  /METHOD=REML
  /PRINT=SOLUTION
  /RANDOM=Scale | COVTYPE(VC).
```

SPSS syntax of the linear mixed model for condition*VS and condition*PT.

```
MIXED zResponse BY Condition WITH zVS zPT
  /CRITERIA=CIN(95) MXITER(100) MXSTEP(10) SCORING(1)
SINGULAR(0.000000000001) HCONVERGE(0, ABSOLUTE) LCONVERGE(0, ABSOLUTE)
PCONVERGE(0.000001, ABSOLUTE)
  /FIXED=Condition*zVS Condition*zPT | SSTYPE(3)
  /METHOD=REML
  /PRINT=SOLUTION
  /RANDOM=Condition | COVTYPE(VC).
```

SPSS syntax of the linear mixed model for VS*PT.

```
GET
  STATA FILE='W:\BA Aesthetics 2014\Data\Tuch2w.dta'.
DATASET NAME DataSet1 WINDOW=FRONT.
MIXED zResponse BY Item Scale Condition WITH zVS zPT
  /CRITERIA=CIN(95) MXITER(100) MXSTEP(10) SCORING(1)
SINGULAR(0.000000000001) HCONVERGE(0, ABSOLUTE) LCONVERGE(0, ABSOLUTE)
PCONVERGE(0.000001, ABSOLUTE)
  /FIXED=zVS zPT | SSTYPE(3)
  /METHOD=REML
  /PRINT=SOLUTION
  /RANDOM=Item | COVTYPE(VC)
  /RANDOM=Scale | COVTYPE(VC)
  /RANDOM=Condition | COVTYPE(VC).
```