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MASTER THESIS

Affective priming as a tool to judge the beauty of a product

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Abstract

Affective priming is an elaborately studied psychological construct where the reaction time on a target word is influenced by a preceded prime. This phenomenon works unconscious for the participant of such a task. This study explores the possibilities of using the affective priming task as an implicit tool to judge the beauty of websites. Implicit testing can be of great value for researchers and marketers because it ensures the absence of social desirability and intentional deception. The reason there is tested for beauty is because it has proven to be a valuable concept due to its link with usability, and usability is one of the major goals in the field of Human Computer Interaction (HCI). The purpose of this study was twofold: 1) to explore the possibilities of using affective priming as a tool to judge beauty and 2) to further explore the underexposed role of emotion in the affective priming paradigm. Our experiment failed to use affective priming as a tool to judge the beauty of websites, the websites probably elicited insufficient arousal for a positive result. In the discussion section, further explanations and directions for future research are provided.

CONTENTS

1. INTRODUCTION

This study explored the possibility to use affective priming as an implicit tool to judge the beauty of websites. The beauty of a product (e.g., a website) is of importance to the user (Bloch, Brunel & Arnold, 2003). It elicits an aesthetic pleasure within the user, people are more likely to buy the product and usability is judged higher in items that are judged more beautiful (e.g. Hekkert, 2006; Leder, Belke, Oeberst & Augustin, 2004). Yet measuring the beauty of something by simply asking people is not always a good idea. In scientific research it can be useful to keep people in the dark about what you are testing. For example when marketers are testing on beauty and want to get an honest, unbiased opinion from the target group, or when it concerns products that are ethically-charged, like cigarettes or alcohol. Implicit tests, as the affective priming task, are less likely to be affected by social desirability and intentional deception. Besides the undesirabilities of explicit testing, the validity of research through questionnaires is often unclear. Bargas-Avila & Hornbaek (2011) performed a meta-analysis of 51 publications on how empirical research on user experience is conducted. They found that more than half of the reviewed publications used questionnaires to measure constructs as aesthetics. Most of the time the papers did not even provide the used items of the questionnaires to the readers, and often if they did, different constructs that were measured seem to overlap. This are not easily avoidable pitfalls for research with questionnaires or Likert scales and can often be avoided by performing implicit testing instead.

Because of the addressed advantages of implicit testing for beauty, it can be valuable for researchers and marketers to have a tool available to perform these kind of tests. Therefore we are going to explore the possibilities of affective priming as a research tool for judging the beauty of websites. Before presenting the experiment of the current study we have to introduce the concepts of beauty, affective priming and emotion against a literary background to clarify the goal of this study.

1.1 Beauty

There is an extensive body of research on the topic of beauty which dates all the way back to the ancient Greece of Plato and is still heavily debated today in the field of User Experience (UX), design, Human Computer Interaction (HCI) and others.

The terminology and definitions of seemingly equivalent concepts often cause ambiguities in this line of research. Terms like aesthetics, beauty, valence, goodness and appeal are intertwined in the literature and often used in a different manner. As Norman (2004b) says; "*if beauty, pleasure, and fun are so essential to our lives, so essential to the design of products and services, then we had better come to understand these concepts*" (p. 312).

Norman (2004a) differentiates 3 levels of beauty. Beauty on a visceral level which operates on the surface and works very fast and subconscious it gives immediate judgments about the valence of an object. Beauty on a behavioral level which is also subconscious but works expectation driven which means something is judged positive if it works as it is expected to work. A mismatch between expectation and experience on the contrary will produce a negative affect. The third level is beauty on a reflective level and works consciously, the brain works on an intellectual level and uses prior experiences to think about and judge objects this is the only level where full-fledged emotions reside. The definition of beauty used by Reber, Schwarz and Winkielman (2004) takes place on a visceral level. They use the words beauty and aesthetic pleasure interchangeably but define it as *"a*

pleasurable subjective experience that is directed toward an object and not mediated by intervening reasoning" (p. 365). And Hassenzahl (2008) defines beauty as *"a predominantly affect-driven evaluative response to the visual Gestalt of an object"* (p. 291), with *goodness* as an overall evaluation of a product. One thing is clear, there is still no uniform definition of beauty.

Beauty does not only elicit an aesthetic pleasure within the user, it also appears to have a strong relationship with usability which makes the construct of beauty more valuable for both manufacturer and user. An elaborate amount of research has been done to discover this particular relation between beauty and usability (e.g., Hassenzahl, 2004; Hassenzahl, 2008; Hassenzahl & Monk, 2010; Kurosu & Kashimura, 1995; Tractinsky, 1997; Tractinsky, Katz & Ikar, 2000).

"What is beautiful is usable" (Tractinsky et al., 2000) was a study exploring perceived usability of ATM's. The study was widely cited and argued that perceived aesthetics affected perceived usability, whereas the actual degree of usability did not affect perceived usability. Hassenzahl and Monk (2010) re-examined the relation between beauty and usability by performing a quantitative study of 15 papers that reported correlations of beauty with usability. They brought some nuance in the discussion regarding the methodological shortcomings. They pointed out that the participants are treated as random effects, but the products used are treated as a fixed effect. This is not justifiable because the correlation between participants and products depends on both constructs. Hassenzahl and Monk (2010) also argued that usability is mediated by the construct goodness (i.e., an overall evaluation), and that the more superficial, subconscious experience of beauty seems to occur on a causal level. Although the link between the beauty of a website and its usability does not appear to have a direct causal connection, beauty does have a positive effect on perceived usability (e.g. Hekkert, 2006; Leder et al., 2004).

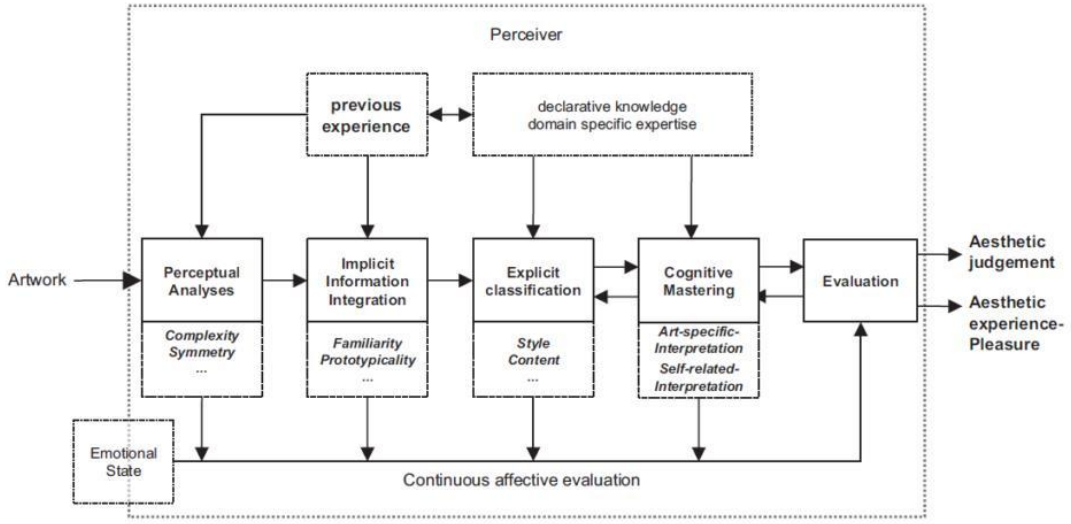
Because of the lack of interaction with the products in the present study (i.e., the screenshots of websites), the beauty will be judged on a visceral level, solely on appearance. This means that the construct goodness does not play a mediating role in the present experiment.

Leder et al. (2004) presented a model of aesthetic experience (Figure 1). This model explains how people experience art, it focuses on understanding the cognitive process of the perceiver. They were the first to develop a model that explains aesthetic experiences on the basis of psychological constructs and include emotion in it. According to the proposed model the processing of art consists of five stages, the first three stages occur automatically and the last two occur deliberately. The automatic part processes the Gestalt, complexity, prototypicality, style and familiarity of the piece of art. The deliberate part processes the interpretation and evaluation. The model generates two types of output, an aesthetic judgment of the piece of art, which is primarily based on the cognitive aspects. And an aesthetic emotion, which depends on the subjective success of the information processing.

Forgas (1995) argues that affective states affect the way an artwork is processed, and also according to Leder et al. (2004) the aesthetic experience of a piece of art is influenced by the mood of the perceiver. They argue that the emotional state and the continuously affective evaluation affects the aesthetic judgment and experience of the perceiver, but they also state that the aesthetic experience of art is a relatively time-consuming process.

Although the model (Figure 1) was developed for art perception, Tuch, Presslaber, Stöcklin, Opwis and Bargas-Avila (2012) state that certain aesthetic variables should also be applicable for HCI research. As they did in their paper exploring the role of visual complexity (VC) and prototypicality (PT) regarding first impression of websites. They argue that the first two stages of the model play an important role in regard to first impressions. The degree of VC and PT proved to have predictive value for the beauty perception of websites (Tuch et al., 2012). That is why the current study also takes the VC and PT scores of the websites into account.

Figure 1. A model of aesthetic experience by Leder et al. (2004).



Beauty proved to be a valuable concept in HCI due to its link with usability. The beauty of objects appear to be influenced by the emotional state of the perceiver (Leder et al., 2004), but the specific role of emotion in affective priming is still unclear and is to be further explored.

1.2 Affective priming

Affective priming, first introduced by Fazio, Sanbonmatsu, Powell & Kardes (1986), is performed by presenting the subject a prime which is almost immediately followed by a target word. The affect of the stimulus used as prime influences the judgment of the target word. The subject is told to categorise the target word as positive or negative as quickly as possible. The congruence or incongruence of the valence of the prime and target, influences the reaction time. If the valence of the prime and target is congruent the reaction time will be shorter, and if it is incongruent it will take the subject longer to categorise the target word.

There are two types of priming that are frequently examined and used, semantic priming and affective priming. Semantic priming uses words as a prime and as a target. If the prime and target are semantically similar (e.g., *giraffe-lion*), the categorisation of the target word takes less time. If they are semantically different (e.g., *giraffe-spoon*) it takes longer to categorise.

Affective priming is much alike, however it is not about semantic similarity between prime and target but it is about similarity of valence. Another difference is that pictures instead of words can be used with affective priming. If the valence of the prime and target are congruent (e.g., a picture of a dead body and the word *cancer*) it takes less time to categorise the target, and if they are incongruent (e.g., a picture of a flower and the word *cancer*) it takes longer.

It has been shown in several studies that the congruence between the prime and target influences the reaction time (see Klauer & Musch, 2003, for an overview). There are three prominent mechanisms that try to explain this priming effect; the spreading of activation mechanism (Bargh, 1997), the response selection mechanism (De Houwer, Hermans, Rothermund & Wentura, 2002) and the affective matching mechanism (Wentura, 2000).

Bargh (1997) argues that the valence of the prime activates an evaluation node which is either sensitive for positive or for negative objects, and this node speeds up the encoding of objects with the same valence. This spreading of activation account for affective priming is no longer strongly adhered. Several results, in particular with lexical decision and pronunciation tasks (Klauer & Musch, 2003), exclude the spreading of activation account as an exclusive explanation (Storbeck & Robinson, 2004). Spreading of activation does occur in semantic priming if there are several possible response alternatives, and if the selection of the correct response depends on the semantic encoding of the targets (De Houwer et al., 2002; Klauer & Musch, 2003).

According to De Houwer et al. (2002) affective priming takes place on the response selection stage, provided that there is only a limited set of possible responses, and all targets of the same valence are assigned to one response. This response conflict takes place at the response selection stage when the valence of the prime and target are incongruent, the response activated by the prime is different from the correct response. This conflict in response selection causes longer reaction times in incongruent trials.

The third mechanism, the affective matching account, only occurs under certain conditions. This mechanism argues that affectively congruent or incongruent word pairs elicit a tendency to answer, respectively, in an affirmative or negative way (Wentura, 2000). This mechanism only seems to occur in lexical decision tasks of affective priming (Storbeck & Robinson, 2004).

1.3 Emotion

Reflecting on previous research we can conclude there is a relationship between emotion or affection and beauty, although full-fledged emotions only appear to occur during a conscious experience with beauty (e.g., Leder et al., 2004; Norman, 2004a). On the other hand, affection has proven to arise in an earlier, even subconscious stage, in research for hedonic experience (Winkielman & Cacioppo, 2001) and processing fluency (Reber et al., 2004; Reber, Winkielman & Schwarz, 1998).

Emotion is commonly explained as the interaction of two underlying dimensions, valence and arousal. Valence and arousal appear to determine emotion/affect (e.g., Colibazzi et al., 2010; Russell, 2003). Most research focuses on the valence dimension of affective priming and almost none on the arousal dimension, while valence and arousal appear to determine affect. Zhang, Kong & Jiang (2012) constitute an exception, they studied the interaction between valence and arousal in the affective priming paradigm. They varied not only between valence (congruent vs. incongruent) but also in arousal (high vs. low). Effects that were obtained through reaction time showed that priming effects mainly interacted with prime arousal, high prime arousal appeared to promote an affective priming effect. This shows us that arousal level has a modulating effect on affective priming.

Full-fledged emotions are not expected to play a role at this specific affective priming task. Common view prescribes emotions cannot be elicited directly from a product besides basic affect without interacting with it or placing it in a context (e.g., Norman, 2004a; Desmet & Hekkert, 2007; Hekkert, 2006). The question, in our study, remains whether this basic affect elicited by the website will be sufficient for an affective priming result.

1.4 Experiment

The aim of the present study was to examine if the affective priming task can be used to judge websites implicitly, we will examine if affective priming as a tool for judging beauty can be an acquisition for researchers. If this is possible, it can be of great value for both marketers and researchers because the visual attractiveness of websites appears to influence perceived usefulness, enjoyment, and ease-of-use (Van der Heijden, 2003) and it appears that the best predictor for the overall judgment of websites is beauty (Schenkman & Jönsson, 2000). Besides that, websites appear to be a suitable product to use for an affective priming task because their visual appeal can be assessed within 50 ms (Lindgaard, Fernandes, Dudek & Brown, 2006). Taking our conditions into account (i.e., the implicit rating of the beauty websites) and based on the available literature an experiment was designed that was most likely to find an affective priming effect.

This leads to the research question of this study: *Is it possible to use affective priming as an implicit tool for judging the beauty of websites?*

This study will not only contribute to the possibilities of affective priming as a tool, but it will also tell us more about the role of emotion and the possible necessity of arousal in affective priming. The outcome will tell if websites elicit sufficient arousal to perform a successful affective priming task.

2. METHOD

2.1 Participants

A total of thirty-four participants (17 women; 17 men) joined the experiment. The participants consisted of friends and family and for the majority of students; the mean age was 23.0 years (sd = 4.24). Twenty-nine participants were native speakers of Dutch and five participants were native speakers of German. Both the Dutch and the Germans were familiar with the target words used in the experiment.

2.2 Materials

Websites with low visual complexity (VC) and high prototypicality (PT) are perceived as highly appealing, and both VC and PT reveal affect on the subjects' perceived beauty within the first 50 ms of exposure (Tuch et al., 2012). Forty-two screenshots of websites were chosen from the same set of websites that Tuch et al. (2012) used in their study. Twenty-one websites that were rated as unappealing and scored high on VC (m = 4.88, sd = .40) and low on PT (m = 3.55, sd = .49), and twenty-one websites that were rated as appealing and scored low on VC (m = 3.29, sd = .38) and high on PT (m = 5.10, sd = .36).

Moors et al. (2013) conducted a word evaluation study, this study was performed to create a valuable source of information for affective research in the Dutch language. Twenty-two Dutch target words were used from that study, eleven that scored highly positive (m = 6.43, sd = .08), and eleven that scored highly negative (m = 1.33, sd = .12).

2.3 Design

An evaluative decision task was used as affective priming mechanism. Screenshots of the different websites were presented as a prime to the participants, the prime was followed by a positive or negative target word. The participants were instructed to attend to the target words and evaluate them as quickly as possible by categorising it as 'positive' or 'negative'. This way all targets of the same valence are assigned to one response, and there is only a limited set of possible responses. This would promote a response selection conflict within incongruent trials (De Houwer et al., 2002). The participants were instructed that the focus in the response task was on speed rather than accuracy, this has proven to give the best results. If the focus is on accuracy their might even occur a reversed priming effect (Hermans, Spruyt, De Houwer & Eelen, 2003).

The onset of the prime and the onset of the target, the stimulus-onset asynchrony (SOA), is also a value to take into account. The automatic nature of affective priming is based on fast-acting automatic processes, short SOA's reveal stronger affective priming results (Hermans, De Houwer & Eelen, 2001; Hermans et al., 2003).

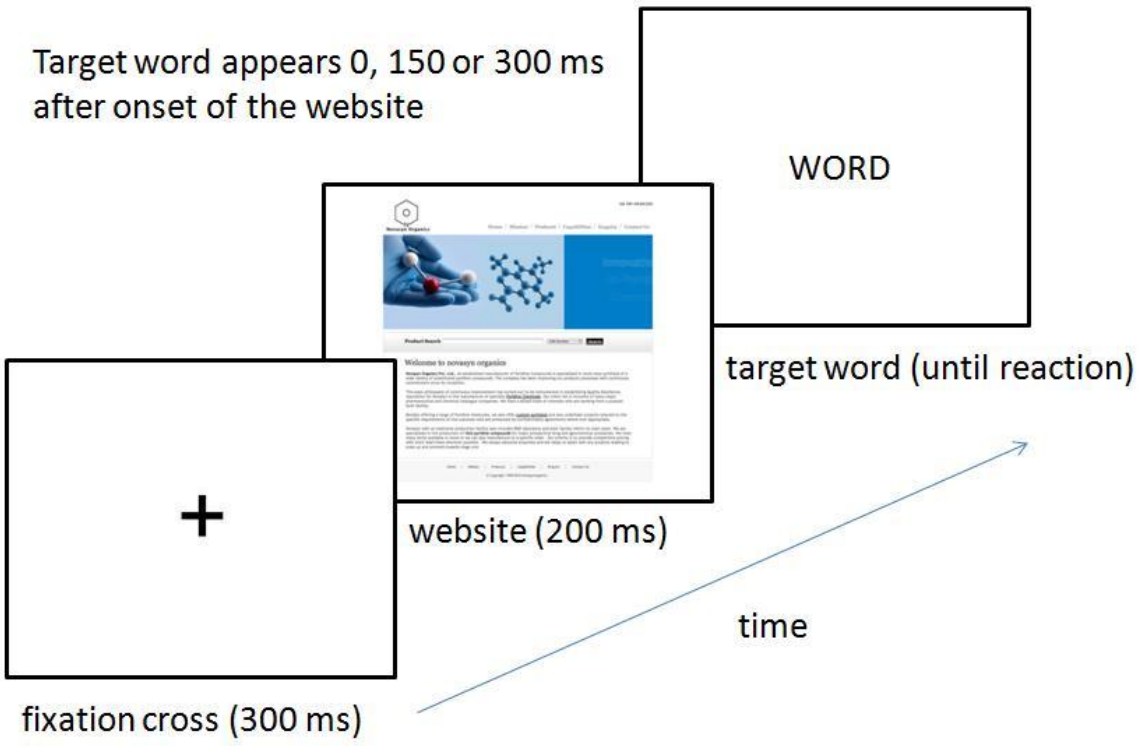
Hermans et al. (2001) did a time course analyses of the affective priming effect, they used positive, negative and neutral words as target as well as for prime. They concluded that the activation curve of affective priming has a quick onset (SOA = 0 ms), with a maximum around a SOA of 150 ms and the edge of the curve is located around a SOA of 300 ms.

The activation curve in the current study was expected to be more or less the same. The prime might be different but it still concerns transfer of the valence of the prime. By manipulating the SOA's we can see if it is the same with affective priming with pictures and we will have a better insight in the involved cognitive processes during affective priming. In conclusion of Hermans et al. (2001) study we used SOA's of 0, 150 and 300 ms.

2.4 Procedure

Each trial started with the presentation of a fixation cross in the centre of the screen (300 ms) followed by the prime. The prime consisted of a screenshot from one of the websites and was presented for 200 ms. After 0, 150 or 300 ms from the onset of the prime, the target word appeared and the subject had to categorise it. With the SOA's of 0 and 150 ms the target word was presented simultaneously with the prime for a brief period of time. During this period the target word was presented in a white box on top of the prime.

Figure 2. Design of the affective priming task.



The categorisation of the words was randomised for handedness in a way that one group of participants was instructed to use the "z" key for negative and the "m" key for positive words. The other part of the participants was instructed to use the "z" key for positive and the "m" key for negative words. The target words were repeated to control for interaction effects and the words were randomised over stimuli across participants.

After the affective priming experiment the subjects were asked to evaluate the screenshots of the websites by means of a visual analog scale (VAS) with the anchors ugly and beautiful. It is argued that the beautiful-ugly dimension represents the primary concept in the aesthetics of objects (Jacobsen, Buchta, Köhler & Schröger, 2004). All ratings were given using a computer mouse to click on the

corresponding area of the scale, ranging from 0-100. This way the outcome of the implicit, affective priming experiment can be compared with the explicit beauty measure of the websites.

The experiment as a whole was developed with E-prime software (v2.0.10.353, SP1), and was conducted in the laboratory of Behavioural Sciences of the University of Twente.

3. RESULTS

From the total of 34 participants we obtained 1428 response time measures, 42 per participant. The erroneous responses were removed and left us with 1302 response time measures, with a mean of 745 ms (sd = 345). In the second part of the experiment the participants rated the websites (n = 42) on their beauty, thereby assigning a beauty score to it using a VAS (m = 44.78, sd = 21.46). Tuch et al. (2012) already assigned VC and PT scores to the corresponding websites. High PT and low VC were perceived as more appealing, low PT and high VC on the other hand as less appealing.

The residuals of the beauty scores appeared to be a symmetrical and unimodal distribution and a regression analysis was performed (Table 1). In our findings, as expected, the beauty score increases when the PT increases (p = .000) and the beauty score decreases when the VC increases, although this did not prove to be significant (p = .262).

Table 1
Multiple Regression Analysis for PT and VC on Beauty

	B	SE	*t*	ß	*p*
(Constant)	8.871	7.306		1.214	.225
VC	-1.036	.923	-.043	-1.123	.262
PT	9.242	.927	.379	9.967	.000

Note. Dependent Variable: Beauty

A graphic rendering of the residuals showed a difference in variance, this means the data is heteroscedastic. The reaction times correlate with each other within a single participant, this is why we should not ignore the repeated measures situation. A classic repeated measures ANOVA or regression analysis cannot provide a correct outcome because the data violates the assumption of homoscedasticity. Mixed-effects models are better in handling unbalanced and incomplete experimental designs, they offer much greater flexibility in choosing covariates and have better statistical power (Gueorguieva & Krystal, 2004). Therefore a mixed-effect modeling procedure is used to deal with repeated measures. Three intercept random effects were introduced; the participants, the words, and the websites. The logarithm of the reaction times (log RT) provide a normal distribution and are therefore used to perform the analysis.

To explore the affective priming effect of the websites and words, the self-assigned beauty scores and the word category (positive vs. negative) are used in the analysis. The negative words were set as the reference group. It was found that when the beauty score increases the log RT for positive words decreases and the log RT for negative words increases (Table 2). The effect that was found is not significant (p = .404) despite the predicted direction of the effects.

Table 2

Mixed-effect Model Predicting Beauty Score for Positive Words with Negative Words as Reference Group

Parameter	Estimate	SE	*p*
Positive	-.043	.043	.314
Negative	0	0	
Beauty	.001	.001	.213
Positive * Beauty	-.001	.001	.404
Negative * Beauty	0	0	

The effects of the PT and the VC scores in combination with the word category on the reaction time were also explored. The negative words were again set as the reference group. The data showed us that the log RT for positive words shortens when the PT increases. The direction of the effect is as expected but far from significant (p = .798). The log RT for positive words were expected to increase when VC increases, but they also decreased instead (p = .878).

Table 3

Mixed-effect Model Predicting PT and VC for Positive Words with Negative Words as Reference Group

	Estimate	*p*		Estimate	*p*
Positive	-.103	.423	Positive	-.089	.477
Negative	0		Negative	0	
PT	.004	.859	VC	.002	.914
Positive * PT	.007	.798	Positive * VC	.005	.878
Negative * PT	0		Negative * VC	0	

To explore differences between the three SOA's and to see if an affective priming effect could be found within one of these SOA's we performed a mixed-effect modeling analysis with word category and SOA as a factor (see Table 4).

Table 4

Difference between SOA's, and Interaction Effect between Beauty Score, Word Category and SOA

	F	*p*
SOA	9.181	.000
Word category * SOA * Beauty	.241	.786

The log RT between the three SOA's differed (p = .000), with the SOA of 150 ms having the shortest reaction time (m = 696, sd = 314). However the different SOA's did not prove to have a significant effect on the affective priming task (p = .786).

4. DISCUSSION

The results showed no significant affective priming effects. The main focus of the experiment was to see if the perceived beauty of the websites influenced the reaction time of the word categorisation. If it did, it was expected that congruent (*beautiful-positive* or *ugly-negative*) trials were shorter in reaction time than incongruent (*ugly-positive* or *beautiful-negative*) trials, due to the response conflict mechanism. In contrast to the target words, the beauty scores are a continuous scale from 0-100 and it was therefore not possible to label each individual outcome as congruent or incongruent. This is the reason we looked at the direction of the effects concerning word category and beauty score.

We saw a direction of the effect that we expected, but it did not prove to be significant. The VC and PT scores also did not prove to be good predictors for an affective priming effect. Hermans et al. (2001) argue that the activation curve of affective priming has a maximum around 150 ms. Although we did find the mean reaction times to be shorter in the 150 ms series, we did not find an interaction effect for that SOA with word category and beauty scores.

There is an elaborate debate on the mechanisms of affective and semantic priming (e.g., Bargh, 1997; De Houwer et al., 2002; Klauer & Musch, 2003; Storbeck & Robinson, 2004; Wentura, 2000). The response selection mechanism seemed most fitting to our goal of finding a priming effect, current experiment was designed in a way that there was only a limited set of possible responses (positive or negative, *z* or *m*), and for every participant all targets of the same valence were assigned to one response. But Zhang et al. (2012) discuss another phenomenon that might be at play during the response selection phase. They argue that higher arousal of the stimuli leads to higher sensitivity to valence congruency. This way it takes more effort to overcome the incongruence at the response selection stage. The role of emotion or (basic) affection has a relationship with affective priming, as discussed in the introduction. Emotion is most commonly explained as an interaction of the underlying dimensions valence and arousal (e.g., Colibazzi et al., 2010; Russell, 2003), and arousal seems to be underexposed in the affective priming paradigm.

According to the response selection mechanism (De Houwer et al., 2002) the conditions of the design of the current experiment seemed sufficient to find an affective priming effect, but they proved not to be. It is likely that the degree of arousal in the stimuli has a part in this.

To explore the boundaries and mechanisms of the priming effect there has been experimented a lot with various tasks (e.g., lexical decision, pronunciation, semantic categorization task), different SOA's, supra- vs. subliminal priming, masked priming, et cetera. But there has not been much variation of different domains in priming stimuli. If pictures were used, it were mostly pictures of wild or dangerous animals vs. cuddly pets or flowers. Murphy and Zajonc (1993) argue these kind of pictures have an "unconscious affect", and this affect is then displaced onto the unrelated target word. Those primes distinguish themselves from the primes of the current study in a way that they elicit more basic instincts like danger or safety and probably have a much higher arousal level (see Figure 3). It is very well possible the primes used in the current study are not arousing enough to elicit such an affect, an affect that is strong enough to be displaced onto the target word. From an evolutionary point of view a picture of a website probably has a less affectious impact than a picture of snake for example.

Figure 3. Comparison between commonly used high affectious pictures of animals vs. screenshots of websites used in current study. *(*Top left*: www.clickreadshare.com. n.d.. Photograph of rabbit. Retrieved from http://www.clickreadshare.com/10-facts-never-knew-bunny-rabbits/*, Top right*: Noah Todd. n.d.. Diamondback rattlesnake. Retrieved from http://survive-prepare.com/2013/01/07/dealing-with-snakes/*, Bottom*: taken from Tuch et al., 2012)*.

Zhang et al. (2012) found significant affective priming effects when either the prime or the target stimuli were highly arousing, and their priming effects proved strongest with a highly arousing prime. The target words that were used in the current study scored a little higher on arousal for the positive (m = 4.79, sd = .90) as well as the negative (m = 4.71, sd = 1.37) words in comparison with the overall arousal score (m = 4.09, sd = .84) of the 4301 words from Moors et al. (2012) study. Yet the arousal level of the prime appears to have the main effect on affective priming, and we did not retrieve any arousal scores of them.

There is a study (Lamote, Hermans, Baeyens & Eelen, 2004) that had a very similar approach as the current study. In that study pictures of food items were used as visual stimuli for the prime. They selected the primes by letting the subjects score the food items on a scale from very unpleasant (-100) to very pleasant (+100), quite similar as the beauty scoring in the current study, but they did find an affective priming effect. They conclude that "*the affective priming paradigm can be successfully applied to track attitudes toward food items that are of extreme as well as of moderate affective meaning*" (p. 284). The scores of the food items that were used were ascribed to the valence of the items and they never mentioned or researched arousal in their study. The fact that Lamote et al. (2004) found an affective priming effect and the current study did not, could mean that mediocre beauty scores in the present experiment prevented a significant result, but it could also indicate that the degree of valence interacts with the degree of arousal.

Affective priming is a fragile phenomenon compared to semantic priming (Storbeck & Robinson, 2004), and it has again proven to be difficult to evoke. We tried to see if the affective priming task could be a suitable tool for the implicit testing of beauty. This study failed to achieve a priming effect

but did give us some insights on the possibilities of affective priming as a tool, and on the underexposed aspects of the affective priming paradigm.

Exploring the field of beauty it became clear that beauty is not just a hedonic experience. Beauty has proven to elicit preference in products (e.g., Salimun, Purchase, Simmons, & Brewster, 2010) and it elicits aesthetic pleasure within the user (Hekkert, 2006), but also has close ties with usability. Usability is one of the major goals in the field of HCI, that is why the implicit measurement of beauty of products can be of great value. That is the reason affective priming as a tool to judge beauty could be a great acquisition for researchers.

Unfortunately the paradigm seems to fragile for a blueprint for a successful affective priming procedure. Returning to our research question; *Is it possible to use affective priming as an implicit tool for judging the beauty of websites?* We can only conclude this is not possible in the current set-up. It might be possible to use affective priming as a tool for judging beauty if our knowledge on the role of arousal is expanded, and when the stimuli are tested on arousal beforehand. But this makes it very impractical as a research tool and probably not appropriate for its goal anymore.

The fact that the arousal level of the websites were not rated is a limitation of the current study, this would have shed some light on the role of arousal in affective priming, and on the probable interaction of arousal and valence. An important recommendation for future research will therefore be to explore what role arousal plays in affective priming. Zhang et al. (2012) already took a valuable step in that direction, but the search for a possible arousal and valence threshold for successful affective priming would be a great asset for the field of HCI and potentially for implicit testing as a tool.

Priming stimuli have two features that appear to influence the success of affective priming, that is valence and arousal, with higher arousal leading to a higher sensitivity of valence congruency. According to Leder et al. (2004) the mood of the perceiver itself also has an influence on the perception of beauty.

Therefore a possible future research can be to further examine the role of emotion in affective priming in two ways, by manipulating the degree of arousal in priming stimuli and by manipulating the mood of the participant. This way you can look for a possible arousal and valence threshold, and explore the effect of the mood of the participant on affective priming. This will ensure a better understanding of the role of emotion and it will make the affective priming paradigm more robust against failure.

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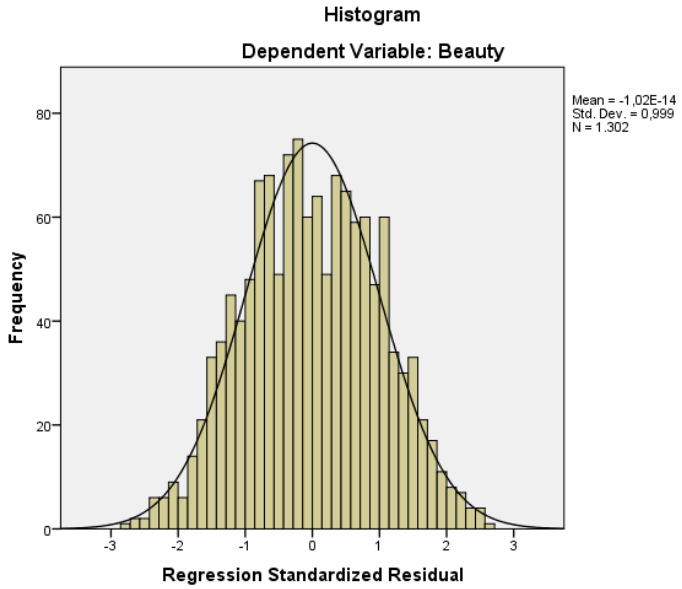
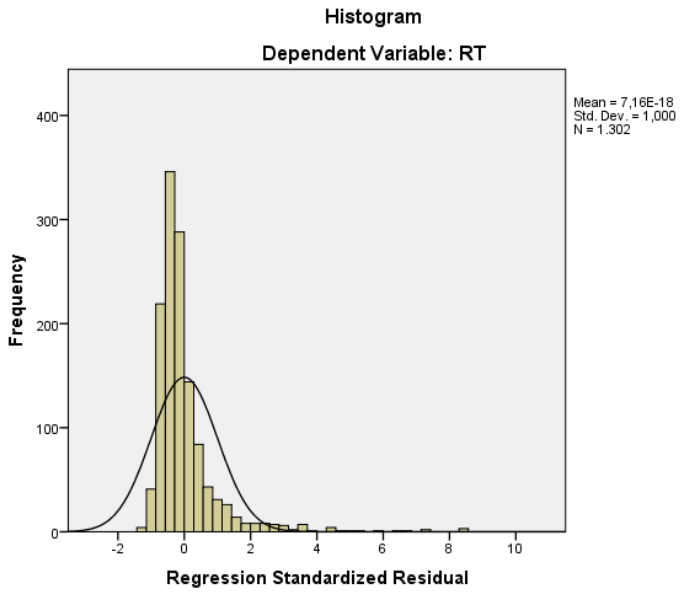
6. **APPENDIX A** - Graphic rendering

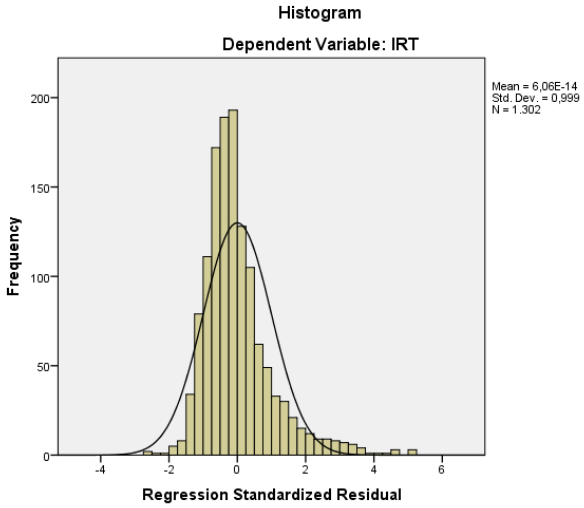
1. Distribution of variance of the residuals (beauty scores)



2. Distribution of variance of the residuals (reaction times)



3. Distribution of variance of the residuals (log reaction times)



APPENDIX B – Syntaxes and figures

1. Regression analysis VC and PT on log RT

```
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(95) R ANOVA CHANGE
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT Beauty
  /METHOD=ENTER VC PT
  /RESIDUALS HISTOGRAM(ZRESID) NORMPROB(ZRESID).
```

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	8,871	7,306		1,214	,225	-5,461	23,204
	VC	-1,036	,923	-,043	-1,123	,262	-2,847	,774
	PT	9,242	,927	,379	9,967	,000	7,423	11,061

a. Dependent Variable: Beauty

2. Beauty and Word category on log RT

```
GET
  STATA FILE='W:\Thesis Michiel Peterkamp\Data\MP.dta'.
DATASET NAME DataSet1 WINDOW=FRONT.
MIXED lRT BY WordCat WITH VAS
  /CRITERIA=CIN(95) MXITER(100) MXSTEP(10) SCORING(1)
SINGULAR(0.000000000001) HCONVERGE(0, ABSOLUTE) LCONVERGE(0, ABSOLUTE)
PCONVERGE(0.000001, ABSOLUTE)
  /FIXED=WordCat VAS WordCat*VAS | SSTYPE(3)
```

```
  /METHOD=REML
  /PRINT=SOLUTION
  /RANDOM=INTERCEPT | SUBJECT(Prime) COVTYPE(VC)
  /RANDOM=INTERCEPT | SUBJECT(Subject) COVTYPE(VC)
  /RANDOM=INTERCEPT | SUBJECT(Word) COVTYPE(VC).
```

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Intercept	6,556004	,047951	78,562	136,723	,000	6,460552	6,651457
[WordCat=1]	-,043224	,042697	94,809	-1,012	,314	-,127990	,041542
[WordCat=2]	0[b]	0	.	.	.	.	.
VAS	,000687	,000551	1088,086	1,245	,213	-,000395	,001768
[WordCat=1] * VAS	-,000607	,000727	1039,664	-,835	,404	-,002032	,000819
[WordCat=2] * VAS	0[b]	0	.	.	.	.	.

a. Dependent Variable: lRT.

b. This parameter is set to zero because it is redundant.

3. PT and Word category on log RT

```
MIXED lRT BY WordCat WITH PT
  /CRITERIA=CIN(95) MXITER(100) MXSTEP(10) SCORING(1)
SINGULAR(0.000000000001) HCONVERGE(0, ABSOLUTE) LCONVERGE(0, ABSOLUTE)
PCONVERGE(0.000001, ABSOLUTE)
  /FIXED=WordCat PT WordCat*PT | SSTYPE(3)
  /METHOD=REML
  /PRINT=SOLUTION
  /RANDOM=INTERCEPT | SUBJECT(Prime) COVTYPE(VC)
  /RANDOM=INTERCEPT | SUBJECT(Subject) COVTYPE(VC)
  /RANDOM=INTERCEPT | SUBJECT(Word) COVTYPE(VC).
```

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Intercept	6,570209	,098279	49,458	66,853	,000	6,372756	6,767662
[WordCat=1]	-,102853	,127230	45,510	-,808	,423	-,359028	,153323
[WordCat=2]	0[b]	0	.	.	.	.	.
PT	,003721	,020816	38,884	,179	,859	-,038387	,045830
[WordCat=1] * PT	,007346	,028558	45,715	,257	,798	-,050148	,064840
[WordCat=2] * PT	0[b]	0	.	.	.	.	.

a. Dependent Variable: lRT.

b. This parameter is set to zero because it is redundant.

4. VC and Word category on log RT

```
MIXED lRT BY WordCat WITH VC
  /CRITERIA=CIN(95) MXITER(100) MXSTEP(10) SCORING(1)
SINGULAR(0.000000000001) HCONVERGE(0, ABSOLUTE) LCONVERGE(0, ABSOLUTE)
PCONVERGE(0.000001, ABSOLUTE)
  /FIXED=WordCat VC WordCat*VC | SSTYPE(3)
  /METHOD=REML
  /PRINT=SOLUTION
  /RANDOM=INTERCEPT | SUBJECT(Prime) COVTYPE(VC)
  /RANDOM=INTERCEPT | SUBJECT(Subject) COVTYPE(VC)
  /RANDOM=INTERCEPT | SUBJECT(Word) COVTYPE(VC).
```

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Intercept	6,578198	,086139	54,976	76,368	,000	6,405571	6,750826
[WordCat=1]	-,089249	,124397	42,281	-,717	,477	-,340242	,161745
[WordCat=2]	0[b]	0	.	.	.	.	.
VC	,002019	,018556	39,011	,109	,914	-,035513	,039551
[WordCat=1] * VC	,004614	,029783	42,945	,155	,878	-,055451	,064679
[WordCat=2] * VC	0[b]	0	.	.	.	.	.

a. Dependent Variable: lRT.

b. This parameter is set to zero because it is redundant.

5. Beauty, SOA and Word category on log RT

```
MIXED lRT BY WordCat SOA WITH VAS
  /CRITERIA=CIN(95) MXITER(100) MXSTEP(10) SCORING(1)
SINGULAR(0.000000000001) HCONVERGE(0, ABSOLUTE) LCONVERGE(0, ABSOLUTE)
PCONVERGE(0.000001, ABSOLUTE)
  /FIXED=WordCat SOA VAS WordCat*SOA WordCat*VAS SOA*VAS WordCat*SOA*VAS |
SSTYPE(3)
  /METHOD=REML
  /PRINT=SOLUTION
  /RANDOM=INTERCEPT | SUBJECT(Prime) COVTYPE(VC)
  /RANDOM=INTERCEPT | SUBJECT(Subject) COVTYPE(VC)
  /RANDOM=INTERCEPT | SUBJECT(Word) COVTYPE(VC).
```

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Intercept	6,556497	,059828	103,578	109,589	,000	6,437850	6,675144
[WordCat=1]	-,078116	,070222	74,388	-1,112	,270	-,218024	,061792
[WordCat=2]	0[b]	0	.	.	.	.	.

[SOA=1]	,105860	,067453	118,775	1,569	,119	-,027706	,239426
[SOA=2]	-,122446	,066958	116,490	-1,829	,070	-,255059	,010166
[SOA=3]	0[b]	0	.	.	.	.	.
VAS	,000837	,000821	1240,993	1,020	,308	-,000774	,002448
[WordCat=1] * [SOA=1]	,004412	,096601	107,167	,046	,964	-,187085	,195908
[WordCat=1] * [SOA=2]	,098288	,096434	108,654	1,019	,310	-,092848	,289425
[WordCat=1] * [SOA=3]	0[b]	0	.	.	.	.	.
[WordCat=2] * [SOA=1]	0[b]	0	.	.	.	.	.
[WordCat=2] * [SOA=2]	0[b]	0	.	.	.	.	.
[WordCat=2] * [SOA=3]	0[b]	0	.	.	.	.	.
[WordCat=1] * VAS	,000377	,001158	1255,742	,326	,745	-,001894	,002648
[WordCat=2] * VAS	0[b]	0	.	.	.	.	.
[SOA=1] * VAS	-,001084	,001223	1230,561	-,886	,376	-,003483	,001316
[SOA=2] * VAS	,000468	,001194	1236,379	,392	,695	-,001875	,002811
[SOA=3] * VAS	0[b]	0	.	.	.	.	.
[WordCat=1] * [SOA=1] * VAS	-,001114	,001669	1224,242	-,667	,505	-,004389	,002161
[WordCat=1] * [SOA=2] * VAS	-,000796	,001670	1239,986	-,477	,634	-,004072	,002480
[WordCat=1] * [SOA=3] * VAS	0[b]	0	.	.	.	.	.
[WordCat=2] * [SOA=1] * VAS	0[b]	0	.	.	.	.	.
[WordCat=2] * [SOA=2] * VAS	0[b]	0	.	.	.	.	.
[WordCat=2] * [SOA=3] * VAS	0[b]	0	.	.	.	.	.

a. Dependent Variable: IRT.

b. This parameter is set to zero because it is redundant.

APPENDIX C – Stimuli

1. List of the 22 target words used in present study (chosen from Moors et al., 2013)

Positive word	Valence score	Arousal score
Geluk (happiness)	m = 6.39, sd = .79	m = 4.73, sd = 1.44
Dolblij (overjoyed)	m = 6.39, sd = .99	m = 5.89, sd = 1.03
Verliefd (in love)	m = 6.38, sd = .86	m = 5.98, sd = 1.05
Vakantie (vacation)	m = 6.34, sd = .74	m = 4.19, sd = 1.77
Liefde (love)	m = 6.53, sd = .85	m = 5.59, sd = 1.39
Beeldschoon (beautiful)	m = 6.47, sd = .71	m = 4.50, sd = 1.38
Heerlijk (delightful)	m = 6.38, sd = .63	m = 4.38, sd = 1.50
Lachen (laugh)	m = 6.36, sd = .72	m = 5.34, sd = 1.06
Vrede (peace)	m = 6.42, sd = .77	m = 2.83, sd = 1.74
Vriendschap (friendship)	m = 6.42, sd = .83	m = 4.70, sd = 1.24
Gelukkig (happy)	m = 6.61, sd = .63	m = 4.64, sd = 1.46

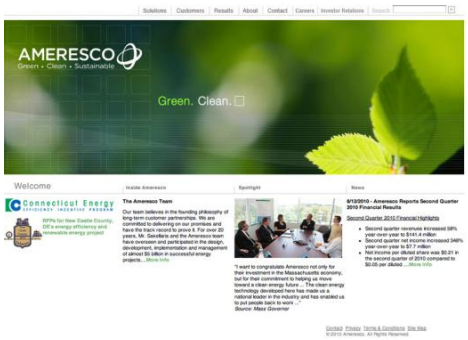
Negative word	Valence score	Arousal score
Incest (incest)	m = 1.20, sd = .51	m = 5.02, sd = 1.63
Verkrachting (rape)	m = 1.31, sd = .79	m = 6.72, sd = 1.09
Doodziek (ill)	m = 1.33, sd = .69	m = 3.66, sd = 2.06
Depressief (depressed)	m = 1.50, sd = .73	m = 2.80, sd = 1.59
Bloedbad (bloodbath)	m = 1.36, sd = .57	m = 6.03, sd = 1.26
Moorden (murder)	m = 1.33, sd = .67	m = 6.39, sd = .81
Pedofiel (pedophile)	m = 1.14, sd = .39	m = 5.00, sd = 1.62
Kanker (cancer)	m = 1.16, sd = .37	m = 4.88, sd = 1.62
Dood (death)	m = 1.38, sd = .65	m = 2.13, sd = 1.86
Tumor (tumor)	m = 1.45, sd = .82	m = 4.91, sd = 1.56
Aids (AIDS)	m = 1.47, sd = .69	m = 4.69, sd = 1.50

2. Four examples of screenshots of websites used in this study (chosen from Tuch et al., 2012)

"Beautiful" websites with low VC and high PT

http://www.jvc.com/
VC (m = 3.27, sd = 2.23)
PT (m = 5.55, sd = 1.53)

http://www.ameresco.com/
VC (m = 3.27, sd = 1.80)
PT (m = 5.45, sd = 1.44)



"Ugly" websites with high VC and low PT

http://www.armedforces-int.com/
VC (m = 5.93, sd = .92)
PT (m = 3.07, sd = 1.59)

http://www.geico.com
VC (m = 5.53, sd = 1.55)
PT (m = 3.60, sd = 1.94)