

Angry and Beautiful: The Interactive Effect of Facial Expression and Attractiveness on Time Perception

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Abstract

Time perception is an adaptive phenomenon that enables everyday functioning, although many of its aspects remain unknown. Previous studies have resulted in new insights regarding this phenomenon, indicating an overestimation of emotional faces presentations, compared to neutral ones. The aim of the present study was to explore if this effect due to emotional expression would be modulated by the attractiveness of the perceived face. Female participants performed a temporal bisection task during which they evaluated elapsed time of female faces presentation differing in facial expression (angry and neutral expression) and attractiveness (attractive and unattractive face) for seven different stimuli durations (400-1.600 ms). Results indicate a systematic overestimation of angry faces duration compared to neutral ones, but only for the attractive face condition, the effect that did not occur for the unattractive face. These findings support the arousal-based models of time perception, indicating that arousal affects time perception mechanism resulting in an overestimation of the perceived time.

Keywords: time perception, emotion, attractiveness, temporal bisection task, arousal

Introduction

It would be difficult to imagine how our lives would look like if we did not have the ability to perceive time. Planning and accomplishing assignments, setting goals in the future, and self-regulation of one's behavior are just some of the examples of activities which would not be possible without the ability to estimate time. Therefore, time perception presents an important mechanism that enables organisms to

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adaptively respond to the environment and efficiently perform everyday life activities.

Various studies have shown that people, like most animals, have the ability to process time information across a wide range of intervals, resulting with accurate time estimation in the milliseconds-to-hours range (Buhusi & Meck, 2005). However, over the last few decades, there are many lines of evidence confirming that perception of time, as a subjective phenomenon, can be influenced by various internal and external factors, resulting with deviations from its actual physical length. Emotions are one of the most studied factors causing systematic bias in time perception (Droit-Volet, Brunot, & Niedenthal, 2004).

The Scalar Expectancy Theory

The most influential theoretical approach in explaining time distortions in response to emotions is the Scalar Expectancy Theory (SET; Gibbon, Church, & Meck, 1984). According to this theory, humans, as well as animals, possess an internal clock, which is responsible for the subjective appraisal of objective physical time units. The metaphorical internal clock mechanism is composed of three basic elements: a pacemaker, a switch, and an accumulator. The pacemaker is responsible for emitting pulses at a given rate, providing a raw material to time perception. Emitted pulses have to pass a switch, that closes at the onset and opens at the offset of the interval being timed, thereby allowing the pulses to enter the accumulator, where they are temporarily stored. The longer the physical period of time, the more pulses are stored in an accumulator, resulting with longer subjective representations of intervals being estimated.

Two mechanisms are supposed to be responsible for temporal bias induced by emotions that influence the functioning of the internal clock: arousal and attention (e.g. Droit-Volet et al., 2004; Effron, Niedenthal, Gil, & Droit-Volet, 2006). According to arousal-based models, increases in arousal accelerate the pacemaker resulting with a greater number of emitted and accumulated pulses in the same physical unit of time. Therefore, increased arousal causes subjective overestimation of time. In other words, arousal-based mechanism postulates that emotional events should be perceived as lasting longer compared to neutral ones. On the other hand, attention-based models postulate that emotional events capture one's attention away from the time processing, causing the underestimation of intervals being timed. In other words, when attentional resources are allocated away from timing, subjective experience of time passage seems shorter than it really is (Brown, 1985). This shortening effect is explained by latency delay of a switch closure or by temporary switch opening, both resulting in loss of pulses stored in an accumulator.

Emotions and Time Perception

The results of the pioneering studies generally support the arousal-based model: Emotional events are perceived to last longer in comparison with neutral ones (Gil, Niedenthal, & Droit-Volet, 2007). For instance, Langer, Wapner, and Werner (1961) demonstrated that genuinely threatening stimuli can lengthen perceived time intervals. In their study, a short interval of 5 seconds was overestimated in a situation when participants were transported on a platform towards a precipice, compared to a situation when they have been moved away from the same precipice. Furthermore, Thayer and Schiff (1975) investigated time perception in the context of social interactions. Results confirmed that reproductions of time intervals spent in an eye-contact with unpleasant (scowling / angry) faces were perceived as longer compared to pleasant (smiling / friendly) faces. Although indicative, these pioneering studies on emotion and time perception have not used standardized emotional stimuli, which puts limitations on the possibility of interpretation and generalizability of their findings (Droit-Volet & Meck, 2007).

However, more recent studies have overcome these methodological shortcomings by using standardized emotional stimuli, such as the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005) and the International Affective Digital Sounds System (IADS; Bradley & Lang, 1999). These bases enable a better insight into the physiological mechanisms underlying time distortions in an emotional context. For example, Angrilli, Cherubini, Pavese, and Manfredini (1997) investigated the influence of valence and arousal on the perceived duration of emotional slide presentation using the IAPS. Their results revealed a significant interaction between these two dimensions: In a high-arousal condition the duration of negative slides was judged longer than positive slides, whereas in a low-arousal condition the duration of positive slides was judged longer than negative ones.

Authors hypothesized that both mechanisms accounted for their findings, an attention-driven mechanism at low arousal levels and an activation-driven mechanism at high arousal levels.

Facial Expressions and Time Perception

Describing emotions in terms of two major dimensions - valence and arousal - contributes to our understanding of mechanisms underlying time distortions. However, it is insufficient to explain different adaptive functions of emotions, that is - specific features of emotions that increase the ability of an efficient coping with threats and opportunities in a given situation (Droit-Volet & Meck, 2007). In a series of studies, Droit-Volet and her colleagues have systematically investigated the effect of perceiving emotional facial expressions on time perception (e.g. Droit-Volet et al., 2004; Gil et al., 2007). From an evolutionary standpoint, facial expressions have a

non-verbal adaptive function as they communicate social and emotional information (Hazlett & Hoehn-Saric, 2000) and hence enable people with appropriate reactions (Gil & Droit-Volet, 2011). The results of these studies showed that the duration of emotional facial expressions was systematically overestimated compared to neutral ones. Authors interpreted their results within the SET: Perceiving other peoples' emotional faces increases arousal, resulting in acceleration of a pacemaker and a greater number of emitted pulses which are stored in an accumulator causing the subjective overestimation of time duration.

The Present Study

Regarding the above-mentioned findings, the present study was designed to investigate the effect of perceiving angry facial expressions and attractiveness of perceived faces on time perception. The facial expression of anger was chosen for its cross-cultural universality and its strongest physiological responses, compared with other primary emotions (Ekman, 1992; Cacioppo & Gardner, 1999). Apart from replicating the effect of time overestimation due to angry faces, this study aimed to extend the existing knowledge by investigating if this effect would be moderated by the attractiveness of the face of the perceived person. Attractiveness represents one of the key characteristics in social information processing - it is one of the first perceived features on another person that influences other impressions and judgments – the effect known as the "attractiveness halo" (Zebrowitz & Montepare, 2008). For example, attractive people are perceived as more intelligent (Eagly, Ashmore, Makhijani, & Longo, 1991; Jackson, Hunter, & Hodge, 1995), competent (Beehr & Gilmore, 1982; Hamermesh & Parker, 2005), trustworthy (Darby & Jeffers, 1988) and socially desirable (Eagly et al., 1991). Moreover, due to its link to the adaptive motivation, it has an important role in a mate selection process (Maner et al., 2003).

Given that attractiveness has been shown to trigger various physiological responses in the observer (Hughes, Farley, & Rhodes, 2010), there are theoretical grounds to assume that it could influence the subjective experience of time passage. Specifically, Ogden (2013) argues that it could affect time estimation via one of the described mechanisms - attention (attractiveness captures attention away from time processing, which leads to an underestimation of time intervals of less attractive stimuli) or arousal (attractiveness increases arousal, which leads to an overestimation of time intervals of more attractive stimuli). However, there seem to be few theoretically grounded studies on time perception that would take this variable into account. On the other hand, those existing studies show somewhat inconsistent results. In a study done by Arantes, Berg, and Wearden (2013), females' estimates of briefly-viewed attractive male photos were significantly longer than corresponding estimates of unattractive male photos. At the same time, there was no difference in estimates between attractive and unattractive female photos. In other words, these authors have shown that attractiveness modulates time perception only while

watching the opposite-sex photos, while same cannot be stated in a same-sex situation. Conversely, Ogden (2013) has found that females' duration estimates of a photography showing an unattractive female face were significantly shorter, compared to a neutral or attractive face. While findings of Arantes et al. (2013) study were attributed to an increased pacemaker rate due to the increased arousal, Ogden's (2013) findings were attributed to the loss of pulses stored in an accumulator due to the allocation of attentional resources from timing to unattractive faces.

In light of these inconsistent findings, this study aims to contribute to the lacking knowledge in the area by investigating females' estimates of duration of a presentation of other attractive and unattractive female's neutral or angry facial expressions. Specifically, we want to test the hypothesis that the overestimation of the perceived duration of presentation of an angry face would be more pronounced when perceiving an attractive face, compared to unattractive one, while observed by the same-sex perceiver. Previous studies hypothesized that perceiving other peoples' angry expressions presents a potentially threatening situation that results with an increased arousal (e.g. Droit-Volet & Meck, 2007). In addition, psychophysiological studies using measures of facial muscle activity have shown that female responses to a photo of another attractive female were associated with greater self-reported arousal and corrugator muscle activity (i.e., frowning), compared to photos of a less attractive female (Hazlett & Hoehn-Saric, 2000). These results were interpreted as an evidence of a defensive reaction to viewing a high-status competitor. In line with this evolutionary hypothesis are the results of studies by Gutierrez, Kenrick, and Partch (1999) and Buss and Shackelford (1997), which implicate that attractive women present potential intrasexual competitor that, in turn, activates the defensive system of the same-sex observer, which aims to guard against potential "interlopers". Therefore, our hypothesis is consistent with the arousal-based model, positing that increased subjective duration associated with additive arousal effect results from engaging the defensive motivational system.

Method

Participants

Participants were 190 undergraduate and graduate female students ($M_{\text{age}}=20.26$ years, $SD=1.76$). They were recruited on a voluntary basis via formal group e-mail informing them about the general purpose of the research (i.e., examining time perception). All participants gave an informed consent.

Material

The experiment took place in a dark laboratory room in front of a computer. Participants were seated approximately 70 cm from the display. Stimuli presentation

and response recording were obtained via the psychological software program E-prime (Schneider, Eschman, & Zuccolotto, 2002). Participants gave their responses on a computer keyboard. Presented stimuli to be timed in a temporal bisection task were a pink oval (visual angle corresponds to $9.1^\circ \times 11.4^\circ$) for the training phases and four photos of adult female faces for the testing phase (equal size as the pink oval). Specifically, stimuli presented two female faces, attractive and unattractive one, both expressing neutrality and anger. Photos were selected from the standardized *Radboud Faces Database* (RaFD; Langner et al., 2010) based on their average attractiveness ratings. We chose the photos with the lowest and the highest rating, $M=1.5$ and $M=3.4$, respectively, rated on a 5-point scale (ranging from unattractive to attractive). List of the selected photos is presented in an Appendix. At the end of the experiment, participants rated two neutral photos on a scale ranging from 1 (*unattractive*) to 5 (*attractive*) in order to verify if the manipulation with attractiveness was successful. A paired-sample *t*-test ($t[189]=22.84$, $p<.001$) confirmed that attractive face ($M=3.75$, $SD=0.80$) was rated significantly higher than unattractive one ($M=2.04$, $SD=0.73$).

Temporal Bisection Task

Participants individually performed a temporal bisection task, which consisted of three successive phases - two training and one testing phase. In the first training phase, participants were presented with a pink oval for two standard durations, a short (400 ms) and a long one (1.600 ms), labeled 1 or 2 respectively. Two standard durations were shown four times each in alternation. Each standard duration had a 50% probability of appearance on each trial. Stimuli were followed by an intertrial fixation cross, which varied randomly between 500 and 1.500 ms. After each presentation, participants' task was to indicate whether they had seen a short or a long stimulus by pressing a key 1 or 2. The purpose of this phase was to familiarize participants with the main procedure. The second phase was identical to the first one, with the exception that stimuli were not labeled and participants were presented with an accuracy feedback after each trial in the center of a computer screen. In the second training phase, standards were shown five times each in alternation.

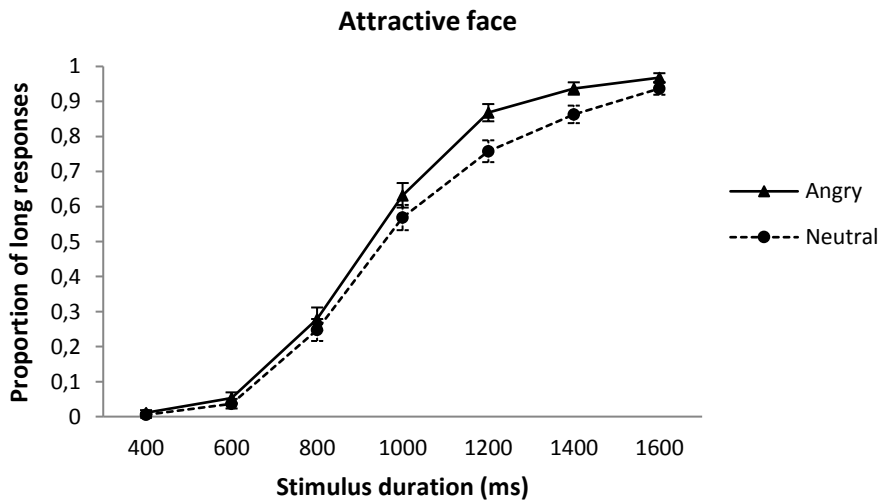
In the test phase, conditions remained the same as in the second training phase except that participants no longer received a feedback and a pink oval was replaced with photos of female faces. In addition, each stimulus was presented at two standard and five intermediate durations (600, 800, 1.000, 1.200 and 1.400 ms). Therefore, each participant completed one block of 28 trials, in which the four photos (2 different women [attractive/unattractive] x 2 different expressions [angry/neutral]) were presented for each of the seven durations in random order. Their task was to classify each stimulus as being more similar to the short, or to the long standard duration, by pressing a key 1 or 2 respectively.

Results

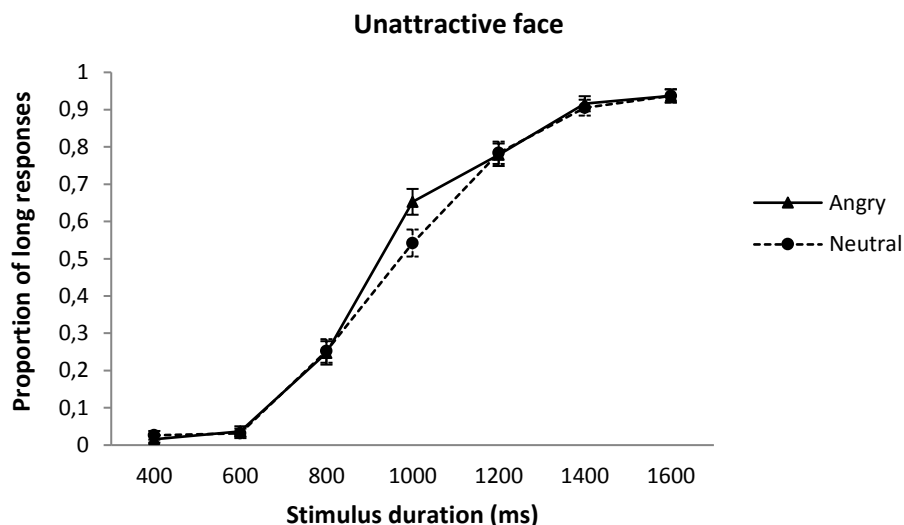
Bisection Function

Bisection functions presented in Figure 1(a) and (b) show the mean proportion of "long" responses plotted against the comparison stimulus durations for angry and neutral faces. The upper panel shows results obtained for the attractive face, whereas the lower panel shows results for the unattractive face. An overview of Figure 1(a) displays a leftward horizontal shift of the bisection function for the attractive face, indicating a temporal overestimation of presentation of angry faces compared to neutral ones. In addition, overestimation seems to be more pronounced at longer than at shorter durations. Conversely, for the unattractive face, there is no difference in the proportion of "long" responses for angry and neutral faces - the functions are almost overlapping, as shown in Figure 1(b).

Figure 1. *Proportion of Long Responses Plotted Against Stimulus Duration for the Attractive (a) and Unattractive Face (b)*



(a)



(b)

Note. Vertical lines represent standard errors of means.

Data Analysis

In order to test these suggestions, a repeated-measures ANOVA with three within-subject factors - duration (400, 600, 800, 1.000, 1.200, 1.400, and 1.600 ms), emotion (angry and neutral face) and attractiveness (attractive and unattractive face) - was performed on the proportion of "long" responses. The analysis revealed significant main effect of duration, $F(6,184)=718.70, p<.001, \eta_p^2=.96$, indicating that participants made correct time estimations, responding more often with "long" responses to longer durations¹. In addition, there was a significant main effect of emotion, $F(1,189)=9.53, p<.01, \eta_p^2=.05$ with presentations of angry faces ($M=0.52, SD=0.12$) being estimated longer than neutral ones ($M=0.49, SD=0.13$). Emotion \times Duration interaction was also significant, $F(6,184)=2.41, p<.05, \eta_p^2=.07$, as well as Emotion \times Attractiveness interaction, $F(1,189)=4.25, p<.05, \eta_p^2=.02$, which was the main focus of our study. Neither the main effect of attractiveness, $F(1,189)=0.61, p>.05, \eta_p^2=.003$, nor any other interactions were statistically significant, namely

¹ We should note that the sphericity assumption, i.e. the assumption on the equality of variances of the differences between treatment levels, has not been met in any reported ANOVA in the Results section (Mauchly's test statistic was $p<.001$). Accordingly, we report multivariate test statistics, a procedure that does not assume sphericity and is more powerful when the violation of sphericity assumption is large ($\epsilon<0.7$) and the sample size is greater than $(a+10)$, with a =the number of levels for repeated-measures) (Stevens, 2002), which is the case in this study.

Attractiveness \times Duration, $F(6,184)=1.36$, $p>.05$, $\eta_p^2=.04$ and Emotion \times Attractiveness \times Duration, $F(6,184)=0.91$, $p>.05$, $\eta_p^2=.03$.

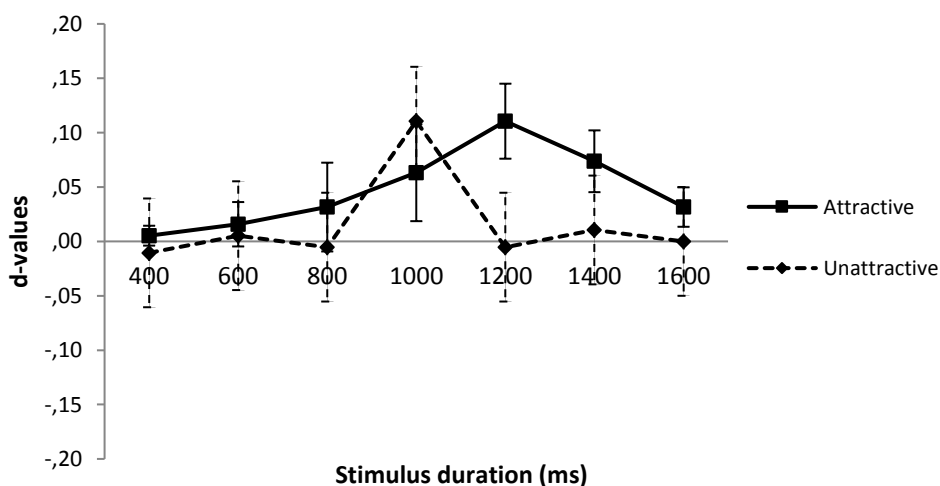
Following the omnibus ANOVA that yielded significant interactions, we performed pairwise comparisons (Bonferroni adjusted) to test individual differences between each level of one independent variable within each level of the other independent variable. With regard to the significant interaction between emotion and duration, pairwise comparison was performed to test the differences in the proportion of "long" responses for angry and neutral facial expressions as a function of stimuli durations. The analysis revealed that the participants significantly overestimated duration of presentation of angry facial expressions compared to neutral ones when stimuli were presented for 1.000 ms, $F(1,189)=6.25$, $p<.05$, and 1.400 ms, $F(1,189)=4.07$, $p<.05$. Differences in proportion of "long" responses for angry, compared to neutral facial expressions, were not statistically significant at the remaining levels of duration, namely: $F(1,189)=0.11$, $p>.05$ at 400 ms, $F(1,189)=0.61$, $p>.05$ at 600 ms, $F(1,189)=0.21$, $p>.05$ at 800 ms, $F(1,189)=3.83$, $p>.05$ at 1.200 ms and $F(1,189)=1.06$, $p>.05$ at 1.600 ms. The finding that the lengthening effect occurs at longer stimuli durations is in line with arousal-based models, supporting the hypothesis that overestimation occurs due to acceleration of clock speed (Burle & Casini, 2001). Furthermore, with regard to significant interaction between emotion and attractiveness, pairwise comparison revealed that presentations of attractive angry face were estimated significantly longer than the presentations of unattractive angry face, $F(1,189)=4.27$, $p<.05$, whereas in the case of neutral facial expressions there was no significant difference between attractive and unattractive face, $F(1,189)=0.50$, $p>.05$. In addition, presentations of attractive angry face were estimated significantly longer compared to attractive neutral face, $F(1,189)=12.98$, $p<.001$, while in the case of presentations of the unattractive faces, there was no significant difference between angry and neutral facial expression, $F(1,189)=1.46$, $p>.05$.

Difference Scores

Finally, to show the extent to which temporal performance regarding angry and neutral facial expressions differed, we have calculated difference scores (d) by subtracting the proportions of "long" responses for angry facial expressions from the corresponding proportions for neutral expressions for both attractive and unattractive face, in each of the seven stimuli durations. This calculation yielded 14 d -values in total. The extent to which d -values are greater than zero illustrates the degree of overestimation of the presentation duration of angry expressions compared with neutral ones. Figure 2 shows d -values plotted against the comparison stimuli durations for the attractive and unattractive face. It can be noted that overestimation occurred only for the attractive face, whereas d -values for the unattractive face are almost universally around zero. To test this pattern, a repeated-measures ANOVA was performed with attractiveness and duration as within-subject factors. This

analysis revealed a significant main effect of attractiveness, $F(1,189)=4.25$, $p<.05$, $\eta_p^2=.02$, confirming that d -values were significantly higher when participants estimated attractive faces ($M=0.47$, $SD=0.18$), compared to unattractive ones ($M=0.02$, $SD=0.17$). In addition, significant main effect of duration, $F(6,184)=2.41$, $p<.05$, $\eta_p^2=.07$ indicated that the lengthening effect of angry expressions varied as a function of stimuli durations. The test of polynomial contrasts revealed a significant quadratic trend, $F(1,189)=5.40$, $p<.05$, $\eta_p^2=.03$. As can be observed from Figure 2, overestimation was more pronounced for longer durations, yet decreasing at the longest one (1.600 ms). Linear and cubic trends were not statistically significant, $F(1,189)=3.70$, $p>.05$, $\eta_p^2=.02$ and $F(1,189)=1.35$, $p>.05$, $\eta_p^2=.01$, respectively. An Attractiveness \times Duration interaction was not statistically significant, $F(6,184)=0.91$, $p>.05$, $\eta_p^2=.03$. To explore if d -values statistically differed from zero, series of single-sample t -tests were performed for both attractive and unattractive face, presented in each stimulus duration. When participants were presented with an attractive face, overestimation occurred at 1.200 and 1.400 ms, $t(189)=3.21$, $p<.01$ and $t(189)=2.59$, $p<.05$ respectively; overestimation for the unattractive face occurred at 1,000ms, $t(189)=2.36$, $p<.05$. Differences at the remaining stimuli durations were not statistically significant from zero - for the attractive face, $t(189)=0.58$, $p>.05$ at 400 ms, $t(189)=0.77$, $p>.05$ at 600 ms, $t(189)=0.77$, $p>.05$ at 800 ms, $t(189)=1.42$, $p>.05$ at 1.000 ms and $t(189)=1.74$, $p>.05$ at 1.600 ms; for the unattractive face, $t(189)=-0.71$, $p>.05$ at 400 ms, $t(189)=0.33$, $p>.05$ at 600 ms, $t(189)=-0.13$, $p>.05$ at 800 ms, $t(189)=-0.13$, $p>.05$ at 1.200 ms, $t(189)=0.39$, $p>.05$ at 1.400 ms and $t(189)=0.00$, $p>.05$ at 1.600 ms.

Figure 2. *Difference Scores (p [long responses] Emotional Expression – p [long responses] Neutral Expression) Plotted Against Seven Stimuli Duration for the Attractive and Unattractive Condition*



Discussion

The aim of this study was to explore the influence of different characteristics of stimuli presentation, facial attractiveness and expression of anger, on time perception. Previous studies have separately explored the influence of emotional expressions (e.g. Droit-Volet et al., 2004; Droit-Volet & Gil, 2009) as well as attractiveness (e.g. Arantes et al., 2013; Ogden, 2013) on time perception. However, to the best of our knowledge, none has so far taken into account the interdependence of these effects in exploring the subjective concept of time.

Our results suggest that the perceived duration is overestimated for the presentation of an angry face compared to a neutral one, the effect which was more pronounced at longer stimuli durations and is consistent with arousal-based models. Internal clock model provides an explanation for this lengthening effect, according to which the number of pulses increases by several times at longer stimuli duration, because of the multiplicativity of pacemaker speed, consequently leading to an overestimation of time intervals. These results are in line with previous studies (e.g. Droit-Volet et al., 2004; Droit-Volet & Meck, 2007).

The main focus of this study was the interaction between emotional expression and facial attractiveness in affecting time perception. Overall results confirmed our expectations, showing that the influence of anger expression presentation on duration estimates was not the same for attractive and unattractive faces. Regarding attractive face, there was a systematic overestimation of angry faces' duration compared to the neutral ones, the effect which did not occur for an unattractive face. Our results are in line with the arousal-based model of time perception (Droit-Volet & Gil, 2009). According to this approach, increases in arousal accelerate the pacemaker mechanism, resulting in the larger number of emitted and accumulated pulses in the same time unit, and consequently in subjective time overestimation.

Attractiveness is introduced in the present study as a potential factor that is expected to affect the arousal of the perceiver. The question that arises is whether it is justified to expect increased arousal in the context where female participants are estimating the duration of same-sex attractive and unattractive faces. Based on the evolutionary rationale, seeing an attractive man as a signal of the potential mate quality is expected to increase arousal. However, the results of the previous studies provide evidence that exposure to photos of attractive same-sex individuals is associated with various physiological and cognitive processes (e.g. Arantes et al., 2013). In an experiment done by Hazlett and Hoehn-Saric (2000), female participants viewed same-sex and opposite-sex targets that varied in their attractiveness, while the corrugator muscle EMG and reported arousal were measured. Results showed greater mean corrugator EMG as well as greater reported arousal while watching highly attractive women compared to less attractive ones. Authors offer a plausible explanation of these results in terms of a defensive reaction to perceiving high-status competitor representing a potential threat (Hazlett & Hoehn-Saric, 2000). Therefore,

the assumption underlying the current study is in line with the results of that study positing that viewing same-sex attractive individual represents a potentially threatening situation which consequently enhances one's arousal.

Ogden (2013) conducted a study with attractive, neutral and unattractive female face presentations, all displaying neutral facial expression, reporting an underestimation of unattractive faces duration compared to attractive and neutral ones judged by female participants. This is not quite in line with our study. However, the aim of the Ogden's study was to explore the effect of attractiveness on the perceived stimuli duration, while the focus of the present study is set on the interactive effect of attractiveness and emotional expression on time perception. Ogden (2013) assigned these results to attention, and not arousal, indicating the possibility that female participants in this study were not aroused enough for arousal effects to be displayed. As the author herself points out, fear-inducing stimuli, such as angry faces used in our study, may induce enough arousal to overcome the attentional effects, resulting in data pattern similar to ours. Ogden does not deny arousal effects due to attractiveness to be present, but in the context of her study finds these effects less pronounced than those due to attention. She also points out that time importance is one aspect of adaptive behavior. When faced with a threatening stimulus such as aggression, it is crucial to act quickly. Angry faces of others, therefore, present a potential threat and activate a defensive motivational system due to arousal, as opposed to controlled attention mechanism active in the low-arousal situations (Angrilli et al., 1997).

Some limitations of the present study should be acknowledged. The magnitude of reported temporal overestimation, expressed with effect size, was considerably low for the interaction effect and moderate for the effect of anger expression, which is in line with previous research done by Droit-Volet et al. (2004). Droit-Volet, Mermillod, Cocenas-Silva, and Gil (2010) offer one possible explanation, according to which, simply viewing photos of angry faces is not as highly arousing as seeing threatening stimuli *in vivo*. An additional limitation refers to the attractive face stimuli. Although the selected photo was the one with the highest rating on attractiveness, it should be noted that this rating was 3.75 on a scale ranging from 1 to 5, compared to the rating of 2.04 for the unattractive face. This difference was significant, but we cannot claim that the attractive photo is indeed very attractive, therefore, a photo with a higher rating, if possible, should be used. The following limitation concerns the number of the models represented on the photographs: In order to maximize the difference in attractiveness we chose the model with the highest and the lowest ratings based on the validation data from RaFD (Langner et al., 2010), as stated above. However, we acknowledge that this decision limits the generalizability of the findings. Accordingly, future studies would benefit from the inclusion of more than one model in order to increase the external validity. Furthermore, attractiveness in the present study was estimated only for neutral faces. Even though we do not expect a different pattern in estimating the facial

attractiveness of angry attractive and unattractive models, and are interested in relative comparisons rather than absolute ones, it could be useful for future research to initially regulate this aspect by having subjects evaluate different facial expressions regarding their attractiveness.

In the context of further research, it would be interesting to explore these effects with both female and male observers viewing male photos, and male observers regarding female photos. This would provide an insight whether attractiveness modulates time perception in different contexts. Another important question for further research is the question of methodology used to estimate time duration. Research findings using different methodological approach are not consistent. Arantes et al. (2013) claim that arousal effects are transient and therefore dependent on methodological factors, such as the time between the stimulus and the participant's response. Various methodological procedures include stimuli reproduction task (Arantes et al., 2013), verbal estimation task (Ogden, 2013), and temporal bisection task used in this study as well as in many previous studies regarding emotional expressions influencing time perception (Droit-Volet & Meck, 2007). Gil and Droit-Volet (2011) compared five different temporal tasks showing that arousal effects are most likely to be observed when the task includes an immediate response after the stimulus is presented, without the comparison with a previous standard. Therefore, findings of the current study should be replicated under different methodological conditions. One of the suggestions for further research is including physiological measures of arousal in time perception experiments.

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Ljuto i prekrasno: Interaktivni učinak facijalnih ekspresija i atraktivnosti lica na percepciju vremena

Sažetak

Percepcija vremena adaptivni je mehanizam koji omogućuje i olakšava svakodnevno funkcioniranje. Dosadašnja istraživanja ovog fenomena pokazuju da ljudi sustavno precjenjuju duljinu prezentacije emocionalnih facijalnih ekspresija u odnosu na neutralne. Cilj je ovog istraživanja bio ispitati ovisi li navedeni efekt o atraktivnosti percipiranog lica. Korišten je zadatak vremenske bisekcije u kojemu su sudionice procjenjivale duljinu trajanja prezentiranih ženskih lica koja su se razlikovala ovisno o atraktivnosti (lice procijenjeno kao atraktivno i neatraktivno) i facijalnoj ekspresiji (lice procijenjeno kao neutralno i ljuto). Duljina prezentiranih podražaja varirala je između 400 i 1600 ms. Rezultati pokazuju da su sudionice precjenjivale duljinu prezentacije ljutih lica u odnosu na neutralna samo u situaciji prezentiranih atraktivnih lica. Navedeni efekt nije potvrđen u situaciji prezentacije neatraktivnih lica. Opisani su rezultati u skladu s modelima koji precjenjivanje vremenskih intervala objašnjavaju na temelju pobuđenosti organizma.

Ključne riječi: percepcija vremena, emocije, atraktivnost, zadatak vremenske bisekcije, pobuđenost

Enfadado y hermoso: Efecto interactivo de expresiones faciales y del grado de atractivo del rostro sobre la percepción del tiempo

Resumen

La percepción del tiempo es un mecanismo adaptado que posibilita y facilita funcionamiento diario. Las investigaciones anteriores de este fenómeno muestran que la gente sistemáticamente sobrevalora la duración de presentación de expresiones faciales emocionales en comparación con aquellas neutras. El objetivo de este trabajo fue investigar si dicho efecto depende del grado de atractivo del rostro percibido. Se usó el ejercicio de bisección temporal en el que las participantes valoraban la duración de la presentación de rostros femeninos que se diferenciaban por el grado de atractivo (rostro percibido como atractivo o no atractivo) y la expresión facial (rostro percibido como neutral o enfadado). La duración de los estímulos presentados variaba entre 400 y 1600 ms. Los resultados afirman que las participantes sobrevaloraban la duración de la presentación de rostros enfadados en comparación con aquellos neutros sólo cuando se trata de rostros atractivos. Los resultados descritos están de acuerdo con los modelos que explican la sobrevaloración de intervalos de tiempo con la excitación del organismo.

Palabras claves: percepción del tiempo, emociones, atractivo, ejercicio de bisección temporal, excitación

Primljeno: 13.07.2015.

List of the Photographs by Radboud Faces Database

<i>Image name</i>	<i>Attractiveness</i>
Rafd090_01_Caucasian_female_neutral_frontal	attractive
Rafd090_01_Caucasian_female_angry_frontal	attractive
Rafd090_22_Caucasian_female_neutral_frontal	unattractive
Rafd090_22_Caucasian_female_angry_frontal	unattractive