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Sex Effect in the Temporal Perception of Faces Expressing Anger and Shame

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The aim of the present study was to investigate sex-related variations in the perception of the duration of emotional stimuli (human faces). Twenty male and 20 female participants estimated the duration of angry, ashamed and neutral faces marking 0.4 to 1.6 s intervals. Female faces were used in one session, and male faces in the other. Compared to the angry faces condition, intervals were underestimated when ashamed faces were shown. However, the intervals in neither conditions were significantly overestimated or underestimated compared to the neutral condition. Even more critical is the fact that there was an underestimation by male participants of the duration of male faces compared to female faces; and female participants overestimated the duration in the anger condition, compared with the shame condition, only when male faces were presented. Moreover, the emotional effects on the participants' performance were correlated to inter-individual differences in empathic abilities. The findings are discussed in terms of sex differences, of social context, and of how attention is solicited and arousal generated by emotions.

The perceived duration of brief time intervals is known to be influenced by several factors like the nature (filled or empty) of these intervals, the modality of stimuli used for marking time (auditory, tactile or visual) and the repetition of these stimuli (Grondin, 2001). Also, when an interval is marked by a continuous visual image, the symbolic meaning of this stimulus will change perceived duration (Mioni, Zakay, & Grondin, 2015). Indeed, the emotional value of this image (Droit-Volet & Meck, 2007; Grondin, Laflamme, & Gontier, 2014; Lambrechts, Mella, Pouthas, & Noulhiane, 2011; Tipples, 2008, 2011), and in particular the emotion expressed if this image is a face, is susceptible to affect perceived duration (Droit-Volet, Fayolle, Lamotte, & Gil, 2013; Droit-Volet & Gil, 2009; Gil & Droit-Volet, 2011a).

In the contemporary time perception literature, it is often reported that the experience of time is based on the output of a pacemaker–counter process (Gibbon, Church, & Meck, 1984; Grondin, 2010). The number of pulses accumulated after being emitted by a pacemaker determines perceived duration. In order to be accumulated, the pulses must pass through a switch which closes when attention is dedicated to timing. Thus, when more attention is dedicated to the passage of time, more pulses are accumulated and duration is perceived as longer (Macar, Grondin, & Casini, 1994). Moreover, increasing arousal accelerates the pace of pulses' emission by the pacemaker and, consequently, perceived duration.

Indeed, experiencing emotion may result in both attentional capture and variations of arousal levels and, consequently, exert influence on perceived duration (Schirmer, 2011). Compared with the presentation of images showing a neutral facial expression, showing expressions of joy, fear or anger leads to an overestimation of time

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(Droit-Volet, Brunot, & Niedenthal, 2004; Effron, Niedenthal, Gil, & Droit-Volet, 2006; Gil, Niedenthal, & Droit-Volet, 2007; Tipples, 2008), with anger causing the largest overestimation (Effron et al., 2006; Tipples, 2008). Because anger faces are interpreted as a potential threat, their view increases the arousal of the observer and, therefore, the speed of her/his pacemaker and, consequently, the perceived duration of presentation of these anger faces (Gil & Droit-Volet, 2011a).

The emotional state of an observer is influenced by the emotion expressed by someone else via a phenomenon called embodiment, which is the inherent tendency to imitate the mimics of another person (Dimberg, 1982, 1990; Dimberg, Andréasson, & Thunberg, 2011). In an experiment on the estimation of the presentation duration of images of faces, Effron et al. (2006) showed that, compared to a neutral condition, showing images of joy and anger leads to overestimation. However, more important is their findings revealing that, when participants held a pen in their mouth so as to inhibit imitation of the faces, they did not overestimate time in the joy or anger conditions.

If imitation is a critical factor for modulating the impact of emotion on perceived duration, this impact might vary as a function of the sex of participants. For instance, imitation behavior and empathy are closely related (Dimberg et al., 2011), with more emphatic people being better at imitating facial expressions – anger or joy, of others. Moreover, it has been shown that women are more emphatic than men (Davis, 1980; Hoffman, 1977). It is also known that women are more inclined than men to feel emotions, and they give higher responses to emotional stimuli expressed (Grossman & Wood, 1993). For instance, recent neuroimaging studies revealed that when presented with negative emotional stimuli, a key structure for processing emotions, the left amygdala, is more activated in women than in men (Stevens & Hamann, 2012).

While the phenomenon of mimicry may explain a large part of the effect of the display of emotional faces on the observers' perception of time, it is important to keep in mind that this effect is also largely driven by the meaning, in a social and adaptive sense, attached to the stimuli presented (Gil & Droit-Volet, 2011b). For example, being presented with a face displaying anger lengthens one's perceived duration only when one feels empathy for and desires to associate with the person whose face is being shown (Mondillon, Niedenthal, Gil, & Droit-Volet, 2007). Interestingly, recent studies have shown that this effect is modulated by the gaze (Doi & Shinohara, 2009) and the direction (Kliegl, Limbrecht-Ecklundt, Dürr, Traue, & Huckauf, 2015) of the angry faces being shown. They found that presenting angry faces with averted gazes or facing away from the observer led to no significant lengthening of perceived duration. This was interpreted as meaning that, for the display of emotional faces to have any effect on a subject's perception of time, he or she must feel that they are the target of the model's displayed emotion. Thus, one needs to take particular consideration of social context when interpreting how primary emotions influence perceived duration through the presentation of faces.

Much of the work on the interpretation of the effect of displaying emotional faces on time perception and how it is influenced by social context has been focused on the effect of primary emotions such as anger. Relatively little is known on the effect of displaying a social emotion such as shame, which is related to self-consciousness felt

when a social rule is broken (Haidt, 2003). According to Gil and Droit-Volet (2011b), presenting faces expressing shame causes an underestimation of time. Seeing the expression of shame on a face, integrating this emotion, and understanding the cause of this feeling likely requires attentional resources (Droit-Volet & Meck, 2007). The attention captured by this nontemporal processing would not be available for processing time, hence the underestimation of duration (less pulses accumulated).

Note that the number of time perception studies involving shame is low and limited to conditions where only women faces were presented (Gil & Droit-Volet, 2011b). This is particularly relevant considering that the effect of presenting faces on time perception may be related to both the sex of the observer and to that of the model whose face is shown. In another study (Chambon, Droit-Volet, & Niedenthal, 2008), participants were presented with old and young faces of women and men. They found that the presentation of older faces leads to more short responses than the presentation of younger faces, but this effect occurred only when the participants and stimulus faces were of the same sex. This was seen as evidence that, when participants are presented with faces of their sex, they feel more compelled to embody their emotion. That being said, Kliegl et al. (2015) failed to reproduce such an interaction of sex concordance when studying the effect of angry faces on time perception. However, they showed that the presentation duration of faces of the opposite sex tends to be overestimated compared to that of faces of the same sex.

The aim of the present experiment is to test the impact of the presentation of faces expressing emotions on perceived duration. Faces expressing anger or shame, which are expected to lead to opposite results, will be contrasted with a condition involving neutral faces (Droit-Volet et al., 2004; Effron et al., 2006; Gil & Droit-Volet, 2011b; Mondillon et al., 2007; Tipples, 2008). More specifically, we are searching for a difference linked to the participants' sex given the individual differences reported for emotions and empathy (Davis, 1980; Doherty, Orimoto, Singelis, Hatfield, & Hebb, 1995; Grossman & Wood, 1993; Hoffman, 1977; Stevens & Hamann, 2012), and are expecting that the effect of the emotional stimuli will be stronger when the participants and stimulus faces are of the same sex (Chambon et al., 2008).

Method

Participants

Twenty men (M = 21.8 years, SD = 1.32) and 20 women (M = 21.55 years, SD = 1.61) were recruited at Laval University. They received $12 for their participation. In order to be recruited, volunteers had to be 18 to 40 years old, had no uncorrected vision disorders and no neurological or psychological disorder that would require medication.

Material and Stimuli

Each participant performed their task individually in an isolated room at Laval University. The room was dimly lit with a small desk lamp so that the participants could see the computer screen clearly. The program that presented the stimuli and recorded the participant's responses was designed using the E-prime 2.0 software, and was under control of an IBM ThinkVision Pentium 4 computer. The pictures of faces

expressing anger or shame, or showing neutral expression, were taken from the « Montreal Set of Facial Expression » image bank (Beaupré, Cheung, & Hess, 2000). A questionnaire for providing an Interpersonal Reactivity Index (IRI) was also used to assess the participants' ability to demonstrate empathy (Davis, 1980).

Procedure

There were two experimental sessions, conducted on two different days. Each session lasted about 30 min. In each session, participants completed a temporal bisection task (Church & Deluty, 1977). In the first session, they were also asked to complete the IRI.

At the beginning of a bisection task, a neutral face of a woman or of a man (depending on session) was presented 10 times for 400 ms (shortest interval) and then for 1600 ms (longest interval), the standard intervals. There was a 500 ms delay between each presentation. Participants were then conducted into four experimental blocks of 84 trials. Before each block, standard intervals were presented only once. In each trial, participants were presented one face expressing anger, shame, or no emotion during 400, 600, 800, 1000, 1200, 1400 or 1600 ms. Within each block, there were four repetitions of each of these 21 conditions: three face types times seven comparison intervals. Participants were asked to report, by pressing on the appropriate keypress, whether the duration of the image presentation was closer to the short or to the long standard. Participants were asked to avoid using any explicit counting strategy. In one session, only woman faces were used; in the other, only man faces. The order was counterbalanced across male and female participants.

Results

A 7-point psychometric function, the function relating the target duration with the proportion of *long* responses, was first drawn for each experimental condition and for each participant. For that purpose, a cumulative Gaussian function was fitted to the proportion of *long* responses for each participant at each of the experimental conditions through a maximum likelihood estimation procedure. The goodness of the fits was assessed with the R^2 statistic. Since the minimum R^2 value was .76, the fits were deemed satisfactory. In the present investigation, the most important dependent variable is the point of subjective equality (PSE). It is defined as the target duration corresponding to a predicted rate of *long* responses of 50%, and it is used as a measure of perceived duration: the smaller the PSE value, the longer the perceived duration. Given this fact, we chose to report and conduct our inferences on the constant error (CE). It is defined as the duration of the actual mid-point between both standards (1000 ms) minus the PSE, so it is positively related to perceived duration. However, the mean PSE values are also provided for better comparison with previous studies.

Another important variable measured in the present study is the Weber Ratio (WR). It is defined as the standard deviation parameter of the fitted cumulative Gaussian curve divided by the actual mid-point between both standards. This variable measures the participants' sensitivity to time or, in other words, their ability to discriminate target intervals. Like PSEs, WRs are negatively related with the attribute it measures; higher WR values denote poorer sensitivity.

Constant Error

The mean CE in experimental each condition is reported in Figure 1. An ANOVA according to a 2 (Sex of participants) $\times$ 2 (Sex of faces) $\times$ 3 (Emotion) design with repeated measures on the emotion and sex of faces factors was conducted on CE. There is a significant emotion effect, $F(2, 76) = 8.91$, $p < 0.001$, $\eta^2_p = .19$, indicating that the CE in the anger condition ($M_{CE} = 25.6$ ms, $M_{PSE} = 974.4$ ms) is larger than that in the shame condition ($M_{CE} = -8.3$ ms, $M_{PSE} = 1008.3$ ms), $p_{Tukey} < 0.001$, $d_{Cohen} = 0.27$, both being non significantly different from the CE in the neutral condition ($M_{CE} = 9.41$ ms, $M_{PSE} = 990.59$ ms), $p_{Tukey} = 0.116$ and 0.077, respectively.

The CE in the woman face condition ($M_{CE} = 22.8$ ms, $M_{PSE} = 977.2$ ms) is significantly higher than that in the man face condition ($M_{CE} = -5.0$ ms, $M_{PSE} = 1005.0$ ms), $F(1, 38) = 5.82$, $p = 0.021$, $\eta^2_p = .13$; but the difference between male ($M_{CE} = -17.1$ ms, $M_{PSE} = 1017.1$ ms) and female ($M_{CE} = 34.9$ ms, $M_{PSE} = 965.1$ ms) participants is not significant ($p = 0.17$). There is no significant double interaction, but the interaction between the three independent variables is significant, $F(2, 76) = 3.20$, $p = 0.046$, $\eta^2_p = .08$.

We decided to take a closer look at this interaction by conducting two 2 (Sex of faces) $\times$ 3 (Emotion) repeated measures ANOVAs, one with male and one with female participants. For female participants, the emotion factor is significant $F(2, 38) = 5.57$, $p = 0.008$, $\eta^2_p = .23$, but the face factor is not ($p = 0.340$). The interaction is significant, $F(2, 38) = 3.43$, $p = 0.043$, $\eta^2_p = .15$, which is indicating that the CE difference between anger and shame conditions is much larger with man, $p_{Tukey} < 0.001$, $d_{Cohen} = 0.49$, than with woman faces, $p_{Tukey} = 0.294$, $d_{Cohen} = 0.17$ (see Figure 1).

As for male participants, the emotion factor is significant, $F(2, 38) = 3.48$, $p = 0.041$, $\eta^2_p = .15$, and the face factor is significant, $F(1, 19) = 6.43$, $p = 0.020$, $\eta^2_p = .25$. The interaction is not significant, $p = 0.600$. The CE is much larger when woman faces ($M_{CE} = 2.2$ ms, $M_{PSE} = 997.8$ ms) are presented than when man faces are presented ($M_{CE} = -36.5$ ms, $M_{PSE} = 1036.5$ ms). As for emotion, only the difference between the mean CE for anger ($M_{CE} = -3.4$ ms, $M_{PSE} = 1003.4$ ms) and shame ($M_{CE} = -32.7$ ms, $M_{PSE} = 1032.7$ ms) is significant, $p_{Tukey} = 0.032$, $d_{Cohen} = 0.22$.

Weber Ratio

Data regarding the WRs are illustrated in Figure 2. While WRs stay constant across the different emotional conditions, they appear to vary with the sex of the stimuli. More specifically, female participants exhibited better sensitivity when presented with male faces ($M_{WR} = 0.231$) than when presented with female ones ($M_{WR} = 0.262$). Male participants, on the other hand, showed the same level of sensitivity for male ($M_{WR} = 0.254$) and female ($M_{WR} = 0.248$) faces. In order to confirm this observation, an ANOVA according to a 2 (Sex of participants) $\times$ 2 (Sex of faces) $\times$ 3 (Emotion) design with repeated measures on the emotion and sex of faces factors was conducted on the WRs. It showed a statistically significant interaction effect between

the Sex of participants and the Sex of faces factors, $F(1, 38) = 5.13$, $p = 0.029$, $\eta^2_p = .12$. No other effect was significant (all ps > 0.05). In order to better understand the Sex of participants $\times$ Sex of faces interaction effect, we tested the simple effect of the Sex of faces factor for male and female participants. The sensitivity to time of male participants was not statistically different when male faces were presented compared to when female faces were presented, $F(1, 19) = 0.41$, $p = 0.530$, $\eta^2_p = .02$. For female participants, however, sensitivity to time was significantly better when male faces were shown than when female faces were, $F(1, 19) = 5.68$, $p = 0.028$, $\eta^2_p = .23$.

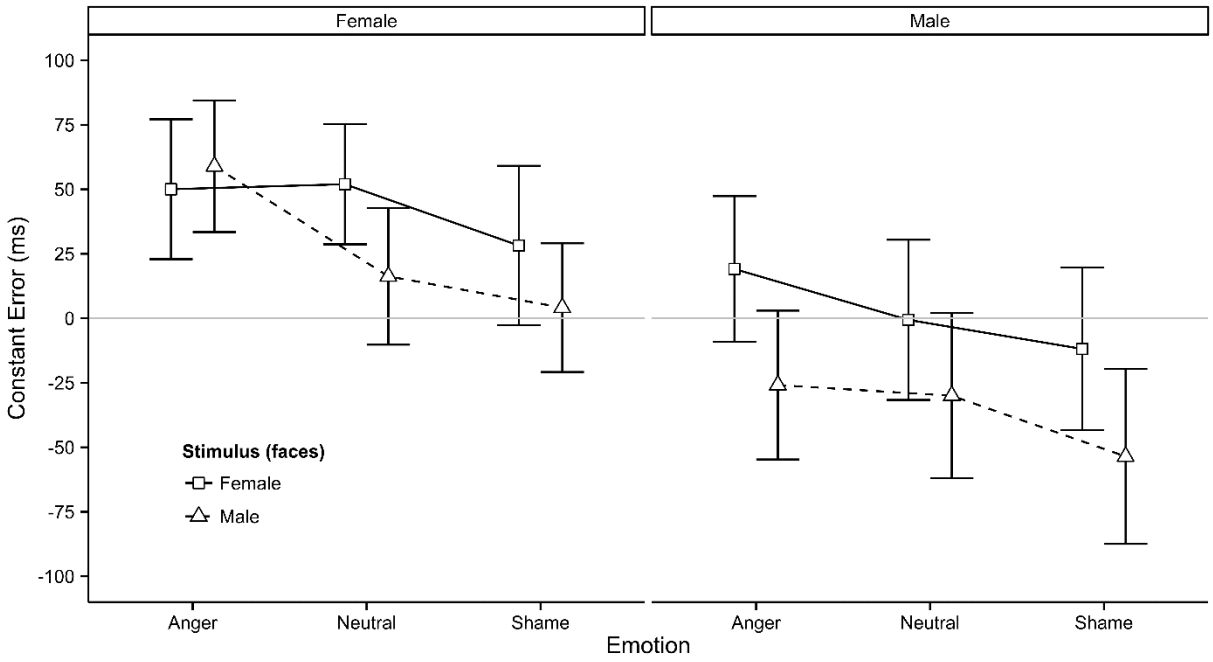

Figure 1. Constant error (in ms) in each emotional condition for female and male participants as a function of men and women (stimulus) faces. The error bars are one standard error wide.

Interpersonal Reactivity Index

A global assessment of the IRI data indicates that female participants scored higher than males on the Perspective Scale ($M_{Males} = 18.75$, $M_{Females} = 19.70$), on the Fantasy Scale ($M_{Males} = 16.10$, $M_{Females} = 16.90$), on the Empathic Concern Scale ($M_{Males} = 16.00$, $M_{Females} = 20.15$) and on the Personal Distress Scale ($M_{Males} = 6.75$, $M_{Females} = 11.80$). However, only with Empathic Concern, $t(36.83) = 2.95$, $p_{Welsh} < 0.006$, $d_{Cohen} = 0.93$, and Personal Distress, $t(32.92) = 3.38$, $p_{Welsh} < 0.002$, $d_{Cohen} = 1.07$, were these differences statistically significant. In order to assess how the different aspects of empathy may modulate the effect of the presentation of emotional faces on perceived duration, we computed the correlations between (1) the participants' score at each of the IRI subscales, and (2) the difference, for CE and WR, between the Anger and Neutral conditions, between the Shame and Neutral conditions and between the Anger and

Shame conditions (see Table 1). The correlations were calculated separately for each participant sex and for each stimulus sex. Regarding the correlations between CE contrasts and the IRI scales, the only statistically significant correlation was the one between the Perspective Taking scale and the Anger vs. Shame contrast of male faces presented to female participants (r = -.467, p = 0.039).

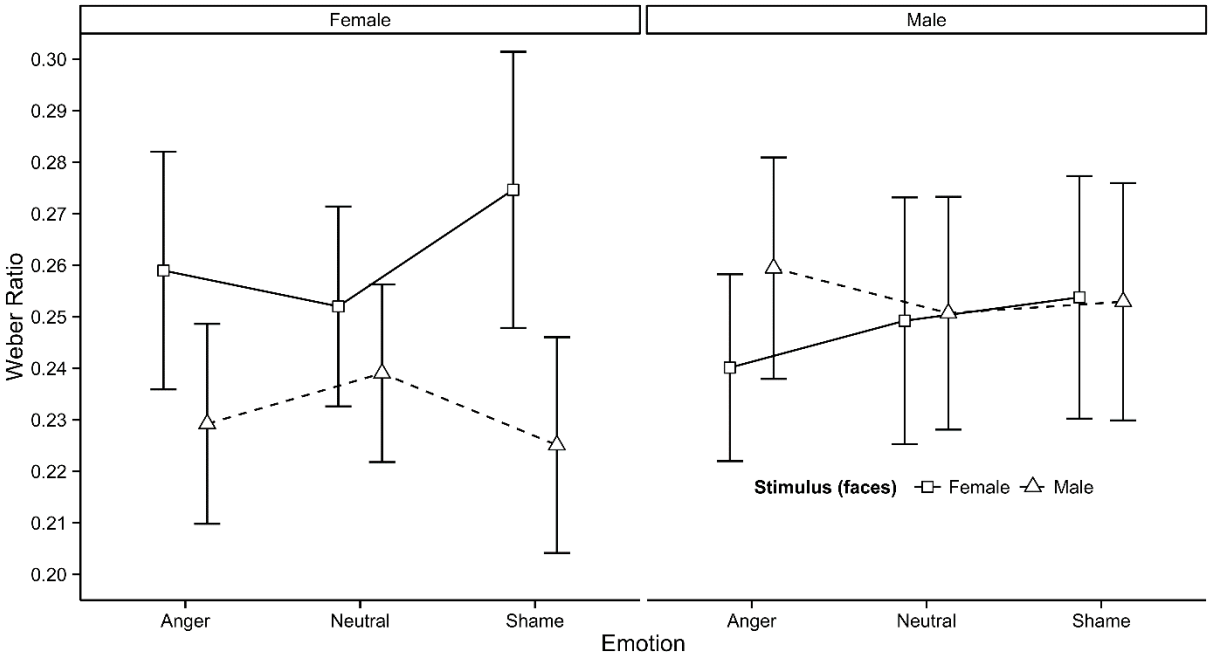

Figure 2. Weber ratio in each emotional condition for female and male participants as a function of men and women (stimulus) faces. The error bars are one standard error wide.

Many correlations between the WR contrasts and the IRI scales were significant. For female participants, the Anger-Shame contrast with female faces was significantly correlated with the Perspective Taking scale (r = .469, p = 0.037). For male participants, the Anger-Neutral contrast with female faces was negatively correlated with the Perspective Taking scale (r = -.445, p = 0.049) and positively correlated with the Personal Distress scale (r = .449, p = 0.047) while the Anger-Shame contrast with female faces was negatively correlated with both the Perspective-Taking scale (r = -.482, p = 0.031) and the Empathic Concern scale (r = -.559, p = 0.010). Finally, the Shame-Neutral contrast with male faces was positively correlated with the Personal Distress scale (r = .492, p = 0.028).

Discussion

Perceived Duration

The CE in the neutral condition was at the mid-point between the CEs obtained in the emotional conditions. The difference between the anger or the shame condition and neutral condition was not statistically significant. In that sense, the present results did not replicate the findings in the literature (Effron et al., 2006; Gil & Droit-Volet, 2011a, 2011b; Mondillon et al., 2007; Tipples, 2008). It should be noted that, in the aforementioned studies, standard durations were marked by the presentation of geometric shapes. In the present experiment, however, standard durations were marked by the presentation of pictures of neutral faces.

Table 1
Correlations (Pearson's r) between the emotional contrasts and the participants' results at each scale of the Interpersonal Reactivity Index questionnaire

	Female Participants				Male Participants			
	PT	FS	EC	PD	PT	FS	EC	PD
Constant Error								
Female Faces								
Anger - Neutral	.191	.107	.235	-.025	-.165	.116	.143	-.006
Shame-Neutral	.311	.209	.196	.130	-.053	.145	.037	.163
Anger - Shame	-.285	-.211	-.068	-.220	-.144	.004	.132	-.154
Male Faces								
Anger - Neutral	.005	.035	-.046	-.051	-.173	.166	.146	-.135
Shame-Neutral	.401	.112	-.110	-.041	.076	-.117	.256	-.309
Anger - Shame	-.467*	-.094	.079	-.008	-.306	.355	-.187	.273
Weber Ratio								
Female Faces								
Anger - Neutral	.046	.095	-.087	-.301	-.445*	.095	-.092	.449*
Shame-Neutral	-.321	-.168	-.295	-.225	.023	-.165	.371	.072
Anger - Shame	.469*	.329	.278	-.066	-.482*	.304	-.559*	.366
Male Faces								
Anger - Neutral	.104	-.190	-.119	-.335	.063	.315	.175	.132
Shame-Neutral	.014	.016	.213	-.148	.250	.197	-.010	.492*
Anger - Shame	.074	-.174	-.299	-.140	-.048	.244	.190	-.086

Note. PT : Perspective Taking, FS: Fantasy, EC: Empathic Concern, PD:

Personal Distress. The correlations are calculated separately for female and male participants, for female and male faces and for each dependent variable in the study, Constant Error and Weber Ratio.

[*] $p < 0.05$

The possibility that this slight modification of the experimental procedure have weakened the emotional effect on time perception cannot be discarded. Also, the effect sizes went in the expected directions. First, the CEs in the emotional condition, anger vs. shame, were significantly different. Secondly, the direction of the results in the anger condition indicated an overestimation of time, a finding consistent with previous findings (Effron et al., 2006; Gil & Droit-Volet, 2011a; Mondillon et al., 2007; Tipples, 2008) and an underestimation was observed in the shame condition (Gil & Droit-Volet, 2011b). Of interest in the present study is the quantification, with the CE, of the mean difference, 34 ms, between the anger and shame conditions.

The difference between the CE in the anger and shame conditions is consistent with the idea that there are two main factors acting on perceived duration, and more specifically on an internal clock (pacemaker-accumulator device), and that both factors can be at play when emotions are manipulated. In the present case, observing shame would be associated with the need to use attentional resources, which decreases attention to time and, therefore, results in the production of more short responses (Gil & Droit-Volet, 2011b). For its part, observing anger would increase arousal and, consequently, would increase the number of pulses emitted by the pacemaker; with more pulses accumulated, time is perceived as longer (Mella, Conty, & Pouthas, 2011).

Thus, the main findings in the present study are related to sex differences. Given the reactivity of women to emotions, their higher level of empathy and their tendency to imitate others' emotion more than men do (Davis, 1980; Doherty et al., 1995; Grossman & Wood, 1993; Hoffman, 1977; Stevens & Hamann, 2012), we expected larger effects of emotions on perceived duration with female than with male participants. The present results indicate that female participants significantly overestimate the duration in the anger condition, compared with the shame condition. Similar results can be observed with male participants, but the magnitude of the effect is not as large. This difference in magnitude between male and female participants is not surprising given the tendency of women to synchronize their emotions with the ones presented, and their reactions to emotions, especially when dealing with negative ones like anger and shame (Grossman & Wood, 1993; Stevens & Hamann, 2012). In that vein, it appears surprising that, overall, women did not overestimate time compared to men. The literature on the effect of sex on time perception is nuanced and not always clear (Grondin & Laflamme, 2015; for a review, see Block, Hancock, & Zakay, 2000), but what is known is that, given the task used for the current study and the length of the target intervals, we should have seen an overestimation of time by female participants (Hancock & Rausch, 2010).

Also surprising was the fact that, while the presentation duration of female faces was overestimated compared to that of male faces for males, female participants did not overestimate the presentation duration of male faces compared to that of female faces as was found by Kliegl et al. (2015). The authors of the latter study explained their results in terms of the social context dating (Buss, 2005). Indeed, they surmised

that their participants were spontaneously evaluating the models in the pictures presented to them for possible mates. According to that explanation, participants would have found pictures of opposite sex more physiologically arousing than pictures of same sex. This interpretation is further supported by Arantes, Berg, and Wearden's (2013) results which indicate that female participants tend to overestimate the presentation duration of attractive male faces compared to that of less attractive ones. The increase of arousal ensures that the pacemaker of the participants' internal clock emits pulses at a faster rate (Treisman, 1963) and leads them to systematically overestimate the duration of faces of the opposite sex.

While this explanation could potentially be applicable to the data of male participants, it fails when it comes to that of female participants who generally underestimated slightly the duration of faces of the opposite sex except for the angry face conditions where female and male faces were judged to last equally as long. On possible way to reconcile the present results with the dating context explanation is to consider that the way female participants evaluated the mating potential of male faces may involve diverting attention away from the timing task and, thus, induce temporal underestimation. For the angry faces conditions, this attentional effect might have been offset by arousal effect due to the perception of threat. Indeed, women process emotional stimuli, particularly aversive ones, differently from men (Bradley, Codispoti, Sabatinelli, & Lang, 2001; Canli, Desmond, Zhao, & Gabrieli, 2002, Grossman & Wood, 1993; Stevens & Hamann, 2012). For female participants, the presentation of angry faces could appear more threatening than the presentation of female faces. For them, the arousal effect of angry faces is thus much greater for male faces than female faces.

Individual Differences

An even richer account of the impact of the social context on the effect of presenting faces displaying shame or anger can be garnered by examining the relation between the inter-individual differences in empathy and effects on time perception measured in the present study. For one, when viewing male faces, the score of female participants at the Perspective Taking scale was negatively correlated with the magnitude of the Anger-Shame CE contrast and marginally and positively correlated with the Shame-Neutral CE contrast. The Perspective Taking scale measures the cognitive abilities related to empathy, i.e. one's capability to spontaneously adopt the other's point of view (Davis, 1983). The present results indicate that the performance of women showing poor Perspective Taking ability is more affected by the presentation of males displaying shame than women who score highly on that scale. The latter subgroup of participants need to spend less attentional resources to decode the social context so more can be dedicated to time keeping.

While there were no significant effects involving the Emotion factor on WR, which measures the participants' sensitivity to time or overall performance at the task, many different profiles emerge when taking into consideration inter-individual differences in empathy. Male participants scoring low in the Perspective Taking scale and high in the Personal Distress one showed poorer performance when viewing angry female faces than when viewing neutral female faces. This observation makes perfect sense within

the dating context explained above. For a male participant looking for a mate, viewing an angry female face may be a source of anxiety and this could negatively impact their performance at the timing task (Kliegl et al., 2015). The performance of male participants naturally predisposed to feelings of unease and distress in tense social settings –those scoring high at the Personal Distress scale of the IRI- would logically be more negatively affected than other male participants. Conversely, male participants who are more inclined to take the perspective of others –as measured by the Perspective Taking scale- could need to spend less cognitive resources when presented with pictures of angry female faces. Indeed, those participants would be less likely to spontaneously view the situation as them receiving negative judgment by a potential mate.

Individual differences in empathy abilities are also tied to the effect of presenting faces displaying the emotion of shame on the participants' performance at the timing task. Male participants who scored high on the Empathic Concern scale –which measures their tendency to feel sympathy for others- tended to show a poorer performance when viewing shameful faces than neutral ones. It is possible that those participants felt more compelled to attend to the cause of the distress shown by the female model in the picture. Such a mental activity requires cognitive resources that are not spent on the timing task, thus causing a difference in performance between the Shame female face and Neutral female face conditions. This situation runs in contrast to that of males viewing male faces. In that case, it is the Personal Distress scale, an index measuring the more selfish and emotional aspects of empathy (Davis, 1983), that is correlated with the Shame-Neutral WR contrast. This indicates that males who experience more self-oriented negative feelings in tense social contexts tend to see their performance diminished when viewing pictures of male faces displaying the emotion of shame than when viewing emotionally neutral male faces. It may be the case that those participants tend to identify themselves with the model of the picture and to internalize the feeling of shame which results in a poorer performance in the timing task (see Gil & Droit-Volet, 2011b)

Conclusion

The present results suggest that perceiving the facial expressions of anger and of shame affects perceived duration. It supports previous claims regarding the social aspect of shame and its need for attentional resources for being processed, and regarding the effect of observing anger on arousal. Much like the effect of the presentation of faces expressing a primary emotion such as anger on time perception, that of the presentation of faces displaying a secondary emotion (shame) is strongly dependent on how those stimuli are interpreted within the social context inferred by the observer. Moreover, the manner by which this interpretation is made is directly tied to the observers' attributes such as their sex and their empathic abilities. The effect of emotion on perceived duration is stronger for female than for male participants, but for men, the sex of the person expressing the emotion on the picture exerts more effect than the emotion itself. Finally, although restricted to a sample of young participants, the results indicate the need to take into account the sex of participants and of the

person expressing an emotion on pictures in the analysis of the effect of emotions on time perception.

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