ABOUT THE EFFECT OF FEAR AND DISGUST ON TIME PERCEPTION

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Abstract

The goal of the present study was to explore the effects of emotions on time perception. More specifically, the effects of three types of stimuli – faces expressing fear (FEF), disgust (FED) and pictures of disgusting food (PDF) – were compared using a temporal bisection task. The results showed that, compared to FEF, time intervals seem significantly shorter when participants are exposed to PDF. However, no other differences were found between conditions. Additionally, there was no statistically significant difference in Weber ratio (WR) between all of the conditions.

Time perception is an integral part of the processing of information required for our day-to-day life (Chambon, Gil, Niedenthal & Droit-Volet, 2005). Temporal properties of various events have to be encoded in order to build temporal representations which, in turn, can be used to make decisions (Droit-Volet, 2005). One's ability to perceive time accurately, to allocate it to various activities and to remember how much time has passed is crucial to his or her social adaptation.

So far, many models of temporal information processing have been elaborated in order to describe and explain the mechanisms underlying perception and estimation of time (Grondin, 2001). To this day, the most popular model used for explaining how time is perceived or estimated probably remains that of Gibbon, Church and Meck (1984). This model, called the scalar expectancy theory, is based on the postulate that a "pacemaker-counter" type of internal clock exists in our mind. It posits that one's perception of a given time interval depends on the number of pulses accumulated in the counter component: the larger the number of accumulated pulses is, the longer the interval will seem. These pulses are emitted regularly by a pacemaker and have to pass through a component called the "attentional switch". In addition to the properties of the internal clock components, temporal judgments could also be influenced by cognitive processes, especially those associated to attention and to memory.

While it is true that each person has the ability to estimate time accurately, empirical research has shown that temporal representations are susceptible to be altered by many types of stimuli (Eagleman, 2008). In particular, the question as to how stimuli illustrating or generating emotions influence time perception is presently the subject of much research. Indeed, it has been demonstrated several times that when a person feels or recognizes some emotions, his or her perception of time is disturbed (Gil & Droit-Volet, 2011a).

Research suggests that certain emotions can potentially accelerate one's internal clock. This will increase the amount of pulses that are stored in the counter during a time interval, consequently causing an overestimation of time (Gil & Droit-Volet, 2011b). Droit-Volet and Gil (2009) explain the acceleration of the internal clock by the intermediate of an automatic process causing an increase of arousal. This arousal facilitates the anticipation of future events and the

preparation to take action. The attentional switch is another structure of the internal clock that can potentially be modulated by emotions (Droit-Volet & Gil), and more particularly by attentional processes. Whenever a person's attention is drawn away from time, some pulses can be lost because of the late closing of the switch at the beginning of the time interval. If less pulses are accumulated, time is underestimated (Gil, Rousset & Droit-Volet, 2009). In that case, attention will again be drawn away from time because of the person's need to adopt a reflective attitude. All those different reactions and temporal distortions are explained by the emotions' signification and by the necessity to react rapidly or not. Thus, the impact of emotion on time perception would depend on their fundamental meaning and their underlying mechanisms (Droit-Volet & Gil).

The goal of the present study was to examine the influence of emotional stimuli. More specifically, the effect of images that induce disgust and fear were of interest. Participants were subjected to three types of stimuli: pictures of disgusting food (PDF), faces expressing disgust (FED) and faces expressing fear (FEF) during a temporal bisection task. It was predicted that an interval would be perceived as shorter when people are exposed to PDF, compared to when they are exposed to FEF. According to our review of the literature, these two conditions represent extremes, or "poles", in term of temporal distortions that can be induced. Previous studies suggest that PDF condition would induce underestimation of time while FEF condition would induce overestimation (Gil & Droit-Volet, 2011a; Gil *et al.,* 2009). Moreover, we also expected that duration would seem longer in FEF than in FED condition. As Gil and Droit-Volet posited, seeing FEF increases one's arousal more than seeing FED, thus inducing an overestimation of time. Finally, we expected that, compared to FED, a time interval would seem shorter when PDF is presented. Indeed, as observed in Gil *et al.*'s study, since PDF influence the attentional processes, that kind of stimuli would induce an underestimation of time. Also, according to Gil and Droit-Volet, the presentation of FED should not induce temporal distortion.

Method

Participants

Eight men and 18 women (mean age = 23 years) were recruited at Laval University. They received 10$ for their participation. In order to be recruited, volunteers had to be 18 to 40 years old, have no uncorrected vision disorders and no neurological or psychological disorder that would require medication. No participant took part in other time perception experiment involving the presentation of emotional pictures.

Material

Each participant performed their task individually in an isolated room at the perception laboratory 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. The pictures of faces expressing fear or disgust were taken from the « Montreal Set of Facial Expression » image bank (Beaupré & Hess, 2000). The pictures of disgusting food, which were validated by Rousset, Deiss, Juillard, Schlich and Droit-Volet (2005) were taken from the «SU.VI.MAX» manual (1994). They were also used in Gil *et al.*'s (2009) study.

Procedure

Each participant completed a temporal bisection task and was subjected to six experimental conditions (two sets of intervals and three types of pictures). There were two counterbalanced sessions of about 30 minutes each. During each session, there were two phases: a learning phase and an experimental one. During the learning phase, participants were presented each of two images (anchor durations) 10 times and were instructed to memorize their duration. They were marked by the onset and the offset of a visual stimulus (a blue circle on a black screen). During the experimental phase, the two anchor durations as well as five others were presented. Durations in this phase were marked by the onset and the offset of one of the three emotional stimulus types (PDF, FED or FEF). In one of the two sessions, the short anchor duration lasted 376 ms and the long anchor duration 1000 ms (short base duration, < 1 s). The five other durations were 480, 584, 688, 792 and 896 ms long. In the other session, the anchor durations were 1000-ms and 1624-ms (long base duration, > 1 s). The five other durations were 1104, 1208, 1312, 1416 and 1520 ms long. Immediately after the offset of the comparison interval, the participants had to respond either "short" by pressing "1" if they thought the comparison interval was more similar to the shorter anchor duration or "long" by pressing "3" if they thought it was more similar to the longer anchor duration.

Results

A 7-point psychometric function was first drawn for each experimental condition and for each participant. Then, a non-linear regression using the cumulative Gaussian function was conducted on each psychometric function.

In order to measure the perceived duration during a temporal bisection task, one usually calculates the point of subjective equality. It is defined as the theoretical duration that would obtain exactly 50% of "long" response. The mean parameter extracted from the non-linear regressions was used to estimate the PSE. Furthermore, those PSEs were divided by the average of the two anchor durations so that the short interval set and the long interval set conditions might be compared. The resulting estimator was called the proportional point of subjective equality (PPSE).

As an index of the participants' sensitivity, the Weber ratio (WR) was used. It is defined here as the standard deviation parameter of the non-linear regressions divided by the average of the two anchor durations.

The PPSE and the WR, the dependent variables of this study, were calculated for each participant, for each type of stimuli (PDF, FEF, FEP) and for each set of durations (376 to 1000 ms and 1000 to 1624 ms). The mean PPSE in experimental each condition is illustrated in Figure 1.

The R^2 coefficient was calculated for each regression. The goodness-of-fit values were relatively high; the mean R^2 value was 0.95. A 2 (sets of durations) X 3 (types of stimuli) repeated measures ANOVA with the Greenhouse-Geisser correction ($\varepsilon = 0.751$) was conducted on the PPSE. The ANOVA yielded a statistically significant (at $\alpha = 0.05$) main effect of stimulus type $F(1.5, 37.6) = 4.10$, $p = 0.03$, $\eta_p^2 = 0.14$. The main effect of the set of durations used and the interaction of the two factors were not statistically significant ($p = 0.65$ and $p = 0.34$, respectively).

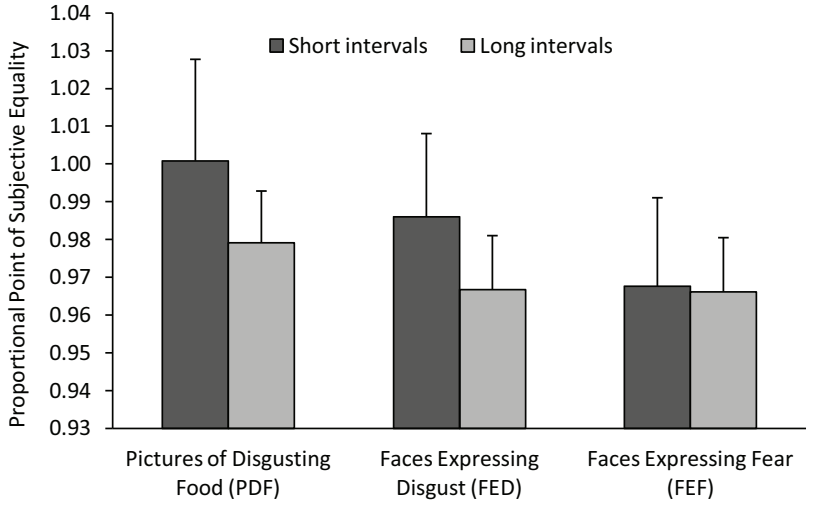

Figure 1. Mean proportional point of subjective equality for each condition of each experiment. Bars are standard error.

Following the ANOVA, three unidirectional paired-sample t-tests were conducted using Bonferroni adjusted alpha levels of 0.0167 per test (0.05/3). The first t-test comparing the PPSE of the FEF (M = 0.967, SD = 0.012) and the PDF (M = 0.990, SD = 0.012) conditions showed a statistically significant difference, $t(25) = 0.023$, $p = 0.04$, $d = 0.39$. The second t-test, which compared the PPSE of the FEF and the FED (M = 0.976, SD = 0.012) conditions, yielded no significant difference, $p = 0.16$. The last t-test, which compared the effect of FED and PDF also yielded no significant difference, $p = 0.19$.

A 2 (sets of durations) X 3 (types of stimuli) repeated measures ANOVA was conducted on the WR. The ANOVA showed no significant effect of the type of stimulus, $p = 0.53$, no significant effect of the set of durations used, $p = 0.73$, and no significant interaction effect, $p = 0.16$. The mean WR in experimental each condition is illustrated in Figure 2.

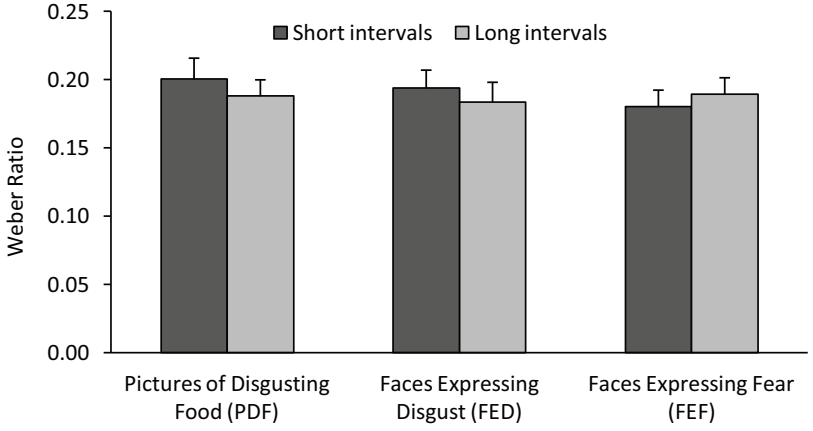

Figure 2. Mean Weber ratio for each condition of each experiment. Bars are standard error.

Discussion

Proportional Point of Subjective Equality

The PPSE difference between the PDF and FEF conditions turned out to be significant. This result suggests that a person perceives time as shorter when he or she is exposed to PDF than when exposed to FEF. These results are consistent with those reported by Gil *et al.* (2009) and by Gil and Droit-Volet (2011a). Indeed, in the 2009 study, the presentation of PDF had induced an underestimation of time. According to the authors, the exposition to PDF draws the participants' attention away from time itself. Additionally, the results from Gil and Droit-Volet indicate that participants who are subjected to FEF tend to overestimate time. The purpose of this alteration of perception would be for the observer to be prepared to react rapidly. In short, the results of the present experiment tend to support the idea that FEF and PDF cause different effects leading to opposite temporal distortions.

Contrary to what was expected, there was no significant PPSE difference between FED and FEF or between FED and PDF. However, according to Gil and Droit-Volet (2011a) and Gil *et al.* (2009), these differences should have been significant. The following three arguments might explain why our results differ from previous data.

First, the experimental designs differed slightly. In Gil and Droit-Volet (2011a) and Gil *et al.* (2009), a greater number of participants were recruited than in the present experiment. This means that the former studies' statistical tests might have been more powerful than those used in the present experiment. However, those studies only involved 9 observations per data point on the individual psychometric functions, compared to 21 in the present experiment. Thus, all other things being equal, the coefficients that were estimated from the psychometric functions should have been more precise and accurate in the present experiment. Since both of the differences in experimental designs yielded opposite effects, it's not clear whether they were the cause of the differences in results.

A second argument that might apply in this case regards the participants' gender as well as the gender of the faces shown. It has been shown in the literature that one's sensitivity to another person's emotions is greater when that other person is of the same gender (Chambon *et al.*, 2005).

The third and last argument is related to the statistical methods employed. As was previously stated, a non-linear regression was used for the present study in order to estimate both of the parameters of interest. Gil and Droit-Volet (2011a) and Gil *et al.* (2009), on the other hand, conducted linear regressions near the inflexion point of the psychometric functions. Since the former method is more accurate and precise than the latter, this could help explain the discrepancies between their results and the present results.

Weber ratio

As for the Weber ratio, there was no statistically significant effect, neither for the type of stimuli (emotions) nor for the duration set (376-1000 ms vs. 1000-1624 ms). These results support the affirmation according to which one's sensitivity to time –the precision of their temporal estimations is not affected by emotional faces. Furthermore, the absence of a significant duration set effect justifies, at least partially, the use of the scalar expectancy theory's theoretical

framework. According this theory, the Weber's law (scalar property) for time should hold, which is consistent with our data (the non-significant effect).

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