ABOUT THE INFLUENCE OF PERCEIVING DISGUSTED, HAPPY AND SAD FACES ON TIME PERCEPTION

Noémie de la Sablonnière, Vincent Laflamme, Katherine Labonté and Simon Grondin
Université Laval, Québec, Canada
noemie.de-la-sablonniere.1@ulaval.ca

Abstract

The aim of the present series of three experiments was to investigate the effect of various emotions (sadness, happiness and disgust) on time perception. In these experiments, temporal bisection tasks were conducted in order to measure the participants' time perception. The various emotions were induced by showing pictures of emotional faces. In Experiment 1, pictures of disgusted and neutral faces were presented and the results revealed an overestimation of time perception when disgusted faces were shown. In Experiments 2 and 3, pictures of happy and neutral faces, and of sad and neutral faces, respectively, were presented. In these experiments, no temporal distortion was found.

The study of the mechanisms behind temporal information processing has a long history. The most popular model used to explain a person's ability to make judgments about time is based on the assumption that there is a "pacemaker-counter" internal clock. It is the accumulation of pulses emitted by the pacemaker that would form the basis for temporal judgments: more pulses accumulated results in longer perceived duration. Judgments about time depend not only on the properties of the internal clock but also on cognitive mechanisms, particularly those tied to attention and memory (Brown, 2008). Indeed, drawing one's attention away from the passage of time results in a reduction of the number of accumulated pulses in the counter and, thus, shortens perceived duration.

Consequently, while it is true that each person has the ability to estimate time more or less precisely, some empirical studies also propose that temporal representations are susceptible to be modulated by external stimuli (Eagleman, 2008). However, one's attention is rarely drawn to the passage of time itself, so it can be difficult to make accurate judgments on it. This is especially true whenever our mind is devoted to more interesting occupations or to emotions.

The effect of emotions on time perception has been gaining more or and more attention from the scientific community. In fact, researchers has been particularly interested in the basic emotions (anger, fear, disgust, happiness, sadness and shame) (Gil & Droit-Volet, 2011a) and the ways to induce them (with emotional pictures or with faces expressing emotions). Even if people cannot know exactly what is felt by the participants in the latter, results showed that the presence and magnitude of the temporal distortions induced depend on which emotion is presented.

Gil and Droit-Volet (2011a) conducted an experiment during which they presented disgusted faces and neutral faces. Their goal was to compare the effect of both types of stimuli on time perception. Their results showed that no temporal bias was being induced by disgusted faces. Gil and Droit-Volet concluded that disgusted faces do not send any socially relevant message. Indeed, according to them, even though disgust is a “high-arousal” and “unpleasant” emotion just like anger and fear, it does not influence time perception in the same way as the two latter emotions because it sends a different social clue to the observer. Since the basic function of disgust is to protect oneself from poisoning, no immediate action would be necessary for a person observing another displaying such an expression (Droit-Volet & Gil, 2009). To the knowledge of the authors, this study has not yet been replicated.

In the study of Droit-Volet, Brunot and Niedenthal (2004), the authors compared the effect

induced by happy expressions (corresponding to Duchenne smile (Duchenne, 1990)) with the ones induced by faces expressing no emotion. Because happiness is a “low-arousal” emotion, the observed temporal overestimations were of low magnitude, but still statistically significant. This study has been replicated by other authors. Effron, Niedenthal, Gil and Droit-Volet (2006) presented faces expressing Duchenne smiles and obtained the same results as Droit-Volet et al. However, Gil and Droit-Volet (2011a) and Tipples (2008) studies showed no temporal distortion from the presentation of faces expressing happiness (non-Duchenne smile). Gil and Droit-Volet posited that the absence of significant results was caused by the fact that the images of faces expressing happiness they used in their experiment didn't show a Duchenne smile. Therefore, they weren't interpreted as genuine smiles by the participants. Conversely, when a person shows a genuine smile, it is interpreted by the observer as an invitation to approach and to make contact. This reaction would in turn increase the observer’s arousal and cause him or her to overestimate time (Droit-Volet & Gil, 2009).

Droit-Volet et al. (2004) also explored the influence of sadness on time perception. In order to do this, they presented faces expressing sadness as well as faces expressing no emotion. In that experiment, a marginally significant overestimation of time caused by sad faces was observed. They concluded that perceiving sadness in someone else sends the message to the observer that it is necessary to give assistance to that person. Consequently, hormones would be secreted in the observer’s organism in order to help the sad person. Those results were replicated by Gil and Droit-Volet (2011a). The latter study even found a statistically significant overestimation. The authors nuanced their findings by specifying that the magnitude of the temporal overestimation brought by the presentation of sad faces was greater in five-years-old children than in older subjects. Thus, they hypothesized that, due to the social inhibition brought by sadness, children eventually learn to suppress that emotion. Alternatively, this attempt to suppress the emotion of sadness could also draw attention away from time and, thus, reduce the number of pulses that are accumulated in the counter component of the internal clock and the resulting temporal overestimation.

The general way by which such stimuli might influence a person's time perception usually takes the form of empathy and pro-social sensitivities. Indeed, Gil and Droit-Volet (2011a) posited that the temporal distortions induced by emotional faces had very specific social utility. Therefore, one's ability to feel empathy may modulate the effect of such stimuli on time perception. The interpersonal reactivity index (IRI) is a questionnaire measuring a person's empathic abilities (Davis, 1980) with four different subscales (each measuring a specific component of empathy). The "perspective-taking" subscale measures one's tendency to adopt another person's point of view. The “empathic concern” subscale measures one’s ability to feel others’ emotions and to feel concerned by the other’s distress. The “personal distress” scale evaluates the anxiety level felt by the persons when they give some assistance to a distressed person. The “fantasy” subscale measures one’s tendency to get caught up in fictional story and to imagine oneself in the same situation as a fictional character. Those additional measures sought to link the magnitude of the effect of emotions on time perception to the different specific measures of empathy.

In order to elaborate further on Droit-Volet et al. (2004), Effron et al. (2006), Gil and Droit-Volet (2011a) and Tipples' (2008) hypotheses, it is imperative first to replicate their findings. Replicating findings is a key component of the scientific method, particularly when studying emotions. Indeed, a large interindividual and intraindividual variability can occur. Moreover, Gil and Droit-Volet (2011b) themselves found that the nature of a task can itself heavily influence the overall results (over- vs. underestimation).

During the course of this study, three experiments using a temporal bisection task were conducted, which involved: (1) faces expressing disgust and neutrality, (2) faces expressing happiness and neutrality and (3) faces expressing sadness and neutrality. The present experiments closely followed the procedures of Gil and Droit-Volet (2011a). In addition, the IRI questionnaire was completed by each of the participants.

General Methods

Participants

For each of the three experiments, 16 students or employees of Laval University were recruited. Each of them received 5$ per session (20$ total). Each session lasted approximately 30 minutes. The participants in Experiment 1 were 21 to 37 years old (M = 25.44). Nine of them were women and 7 were men. In Experiment 2, participants were 20 to 38 years old (M = 26.81). Ten of them were women and 6 were men. In Experiment 3, the age of participants (10 women and 6 men) ranged from 20 to 38 years old (M = 23.00). All participants took part in only one experiment.

Material

Each participant performed his or her task individually in an isolated room at the perception laboratory at Laval University. The room was dimly lit by a small desk lamp so that the participants could see the computer screen clearly. The program that presented the stimuli and recorded the participants' responses was designed using the E-prime 2.0 software. In order to respond, the participants had to press either the "1" key or the "3" key of the keyboard. The visual stimuli (5 neutral faces, 5 faces expressing disgust, 5 faces expressing sadness and 5 faces expressing happiness (non-Duchenne smile)) were sampled from the “Montreal Set of Facial Expressions” (Beaupré, 2000). They were presented on 7 X 10 inches computer display (IBM Think vision with an 80 Hz refresh rate). The experiment was under control of an IBM Pentium 4 computer.

Procedure

At the start of the first session, each participant was invited to complete the IRI questionnaire. Once they were done, the participants had their task explained to them and they were given an instruction sheet. They were then led to the room where they performed their task. Just like in Gil and Droit-Volet's studies (2011a), a temporal bisection task was used. In each experiment, there were 4 identical sessions lasting approximately 30 minutes. At the start of each session, the participants completed a learning block during which each of the two anchor durations (400 and 1600 ms) was presented 10 times to them. Each anchor duration was delimited by the onset and the offset of a picture of a neutral female face. After each presentation of the anchor durations, there was a 3500-ms delay. After the learning block, the participants completed a 14-trial practice block and were given feedback on their performance after each trial. The participants then had to complete 4 experimental that each were comprised of 70 trials. During each trial of the practice and the experimental blocks, the participants were presented a comparison interval which would last either 400, 600, 800, 1000, 1200, 1400 or 1600 ms. These intervals were delimited by the onset and offset of a visual stimuli which could either be a picture of a neutral face or a picture of an emotional face. For each type of visual stimuli, there were 3 male and 2 female faces. 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

The proportion of "long" responses was calculated for both conditions in each of the three experiments (neutral faces and emotional faces). Nonlinear regressions using the cumulative Gaussian function were then conducted on the proportion of "long" responses. From these regressions, two parameters were extracted: the mean and the standard deviation parameters of the regression curve. The mean parameter was used as an estimator of the point of subjective equality (PSE) and the standard deviation parameter divided by 1000 ms was used as an estimator of the Weber Ratio (WR). The larger the PSE, the shorter

time is perceived. A large value of WR is associated with a lesser sensitivity to time. For each experiment, a paired samples t-test (emotional vs. neutral) was conducted on the PSE and on the WR. Figure 1 summarizes the mean PSE obtained in each condition of each of the three experiments.

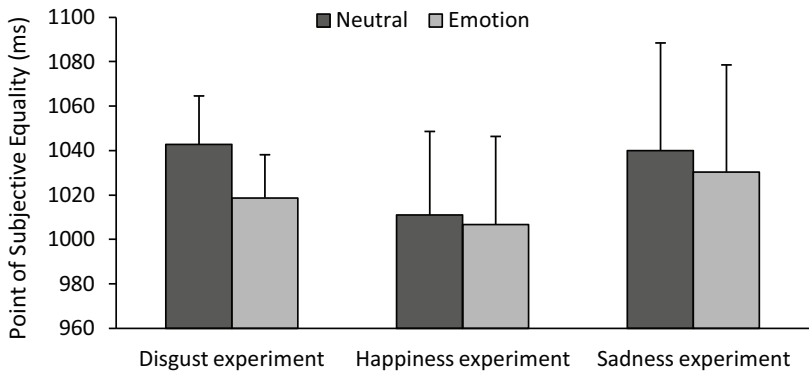

Figure 1. Mean point of subjective equality for each condition of each experiment. Bars are standard error.

Experiment 1: Disgust
The PSE of the neutral faces condition was significantly higher than that of the disgusted faces condition, $t(15) = 3.326$, $p = 0.005$, $d = 0.877$. For the WR, the difference was not significant ($p = 0.298$).

Experiment 2: Happiness
The difference between the neutral faces and happy faces conditions was not significant. This findings applies to both PSE ($p = 0.603$) and WR ($p = 0.680$).

Experiment 3: Sadness
The difference between the neutral faces and sad faces conditions was not significant. This findings applies to both PSE ($p = 0.342$) and WR ($p = 0.485$).

IRI scores
To test the hypothesis that an individual's empathic abilities modulates the effect of the presentation of disgusted faces on his or her time perception, correlation indexes (Pearson's r) were calculated between the difference of PES between the disgust and neutral conditions and the score at each of the IRI subscales. None of the correlation indexes were found to be significantly different from 0.

Discussion

Experiment 1: Disgust
The presentation of disgusted faces induces, at least in the current study, an overestimation of time as compared to the presentation of a neutral faces. This could mean that this emotion, when expressed by another person, results in an increase of the observer's arousal. This would seem to contradict Gil and Droit-Volet's (2011a) findings where the very same stimuli did not induce any temporal distortion and, therefore, did not influence the observer's internal clock. They concluded that disgusted faces do not send any socially relevant message.

Given that the results of the present experiment are inconsistent with Gil and Droit-Volet’s

(2011a) findings about the effect of disgust, perhaps the expression of disgust in another person is interpreted by an observer as a social clue. While the expression of disgust is often associated with the sight of rotten food or other types of contaminants, it can also arise when a person witnesses another committing immoral acts (Chapman, Kim, Susskind, & Anderson, 2009). The latter is known as moral disgust. The participants of this experiment could very well have interpreted the disgusted faces as a sign of disapproval. Consequently, their time perception would have been influenced in a manner that is similar to that of angry faces (Gil & Droit-Volet, 2011a,b): their level of arousal would have been increased as they prepared for eventually defending themselves.

Experiment 2: Happiness

Given the present experiment's results, it would seem that presenting faces expressing happiness does not induce any statistically significant temporal bias in the observer. This finding supports Droit-Volet and Gil (2009) and Gil and Droit-Volet's (2011a) hypothesis. Indeed, those researchers thought that the presence or the absence of temporal distortion was explained by the presence or the absence of Duchenne smile, respectively. This explanation could also hold for the present experiment since, like in Gil and Droit-Volet, the images were taken from the "Montreal Set of Facial Displays of Emotion" (MSFDE). Thus, the way by which people interpret happy expressions would depend on the type of smile expressed. Since people learn to smile in many other situations than when they genuinely feel happy, it is possible that they learn to distinguish true expressions of happiness from "social" smiles. These two expressions would then have two different significations.

Experiment 3: Sadness

According to the results from the present experiment, there is no distortion in time perception when participants are presented pictures of sad faces, as compared to neutral faces. This finding contradicts those of Droit-Volet et al. (2004) and of Gil and Droit-Volet (2011a). However, just as Gil and Droit-Volet proposed, it could be that when the subjects are presented sad faces, their attention is drawn away from time in order to repress their negative emotion. This would explain why some studies find temporal distortions of very low yet statistically significant magnitude while others find no significant effect of the sad faces on time perception.

IRI scores

The empathic abilities of the participants were measured by the various subscales of the IRI. Consequently, it was expected that there would be a relationship between those scores and the magnitude of the temporal biases measured in the present experiment. This was not the case, since there were no statistically significant correlations between the scores at the various subscales and the differences in PSE. These results would therefore suggest that empathy have no, or perhaps very limited, influence on how emotional faces cause distortions in a participant's time perception. Then again, given that none of subjects lacked empathy in a pathological way, it could still be possible that the link between empathy and the effect of emotional faces on time perception is a dichotomic one and not a matter of degree. In other words, one would only need a minimal amount of empathic abilities to have his or her time perception influenced by other people's facial expressions. Therefore, it would be interesting to conduct a similar experiment and to recruit participants who suffer from empathic disorders (psychopathy, for example).

Another explanation for this lack of statistically significant link could be that the durations studied here were too short for the participants to process emotional expressions consciously. It is thus possible that the participant's reaction to the emotional faces was automatic and physiological in nature. Since empathy is processed consciously, it would have little impact on time perception.

WR scores

As was expected, there was no statistically significant effect of emotional faces on the WR. These results support the idea that these types of stimuli do not influence a person's sensitivity to time. In other words, the precision of one's temporal judgments is not affected by the emotional stimuli.

Final comments

Even though the main goal of the present study was to replicate Gil and Droit-Volet's (2011a) findings, some methodological differences were nevertheless introduced. Those differences could have improved or hindered the present study's validity. First of all, the present experiments took a much greater number of observations per point on the psychometric functions (80 vs. 9) in order to increase the robustness of the estimators, the PSE and the WR. Secondly, the images that delimited the anchor durations shown during the learning block depicted neutral faces instead of pink ovals as in Gil and Droit-Volet's studies. Thirdly, each of the anchor durations was presented 10 times successively during the learning of the present study rather than 4 times each in a random order. This change was done so that participants may learn the anchor durations more easily and more accurately. Fourthly, both the stimuli and the participants were of both genders. This aspect might explain why the present study yielded smaller effects than those of Gil and Droit-Volet since the latter used only female participants and female stimuli. Finally, the statistical method employed in the present study consisted in conducting non-linear regressions on the psychometric functions using the cumulative Gaussian function. In contrast, Gil and Droit-Volet's estimated their parameters by linear regression near the inflection point of the psychometric function. The method employed in the present study is more accurate and precise.

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