How Liked and Disliked Foods Affect Time Perception

Sandrine Gil
Université Blaise Pascal

Sylvie Rousset
Institut National de la Recherche Agronomique

Sylvie Droit-Volet
Université Blaise Pascal

The purpose of this study was to investigate the influence on time perception of pictures showing liked or disliked foods in comparison with a neutral picture. Healthy adults performed a temporal bisection task in which they had to categorize the presentation duration of pictures (neutral, liked, and disliked foods) as more similar to a short (400 ms) or to a long (1,600 ms) standard duration. The data revealed that the presentation duration of food pictures was underestimated compared with the presentation duration of the neutral picture, and that this underestimation was more marked for the disliked than for the liked food pictures. These results are consistent with the idea that this time underestimation arises from an attentional-bias mechanism. The food pictures, and particularly those depicting disliked food items, distracted attention away from the processing of time.

Keywords: time, time perception, emotion, disgust, food

Imagine that you are sitting comfortably in a restaurant, eating a delicious meal that you have chosen because it is your favorite dish. In this situation, time seems to fly. In contrast, if you are faced with food that disgusts, does time still seem to pass so quickly? Although this feeling of time is experienced every day, no study has as yet examined the mechanism underlying food-elicited emotion on time perception. The aim of the present work was therefore to investigate the relationship between food-elicited emotion and time perception.

In the field of time psychology, the most prominent model is the information-processing model derived from scalar timing theory (Gibbon, 1977; Gibbon, Church, & Meck, 1984). According to this model, humans possess an internal mechanism allowing them to process time accurately, that is, the internal clock. This clock possesses three components: a pacemaker, a switch, and an accumulator. The pacemaker emits pulses at a given rate, and the switch closes at the beginning of the stimulus that is to be timed, thus allowing the pulses to enter the accumulator. At the end of the stimulus, the switch opens and the transfer of pulses stops. The quantity of pulses stored in the accumulator thus determines estimated time: The more pulses that are accumulated, the longer the time is judged to be. Although this pacemaker–internal clock system allows humans to estimate time accurately, time is often judged shorter or longer than it really is. Among the causes of variation in time judgments, two main sources have been identified: arousal and attention. First, a substantial body of research has shown that an increase in the level of arousal also increases the speed of the pacemaker. Thus, when the clock runs faster, for a given stimulus duration, the number of pulses accumulated is greater than normal, and the duration is judged longer. A broad basis of support for this arousal-related overestimation effect has been provided by studies that have manipulated the arousal level, either by means of an increase in body temperature (for a review, see Wearden & Penton-Voak, 1995), through the presentation of rhythmical stimuli (Droit-Volet & Wearden, 2002; Penton-Voak, Edwards, Percival, & Wearden, 1996), or through the administration of dopaminergic drugs (MacDonald & Meck, 2005; Maricq & Church, 1983; Matell, King, & Meck, 2004; Meck, 1996). Second, according to attentional models of time (Thomas & Weaver, 1975; Zakay, 1989, 1992; Zakay & Block, 1996), the more attention is diverted away from the processing of time, the shorter time is estimated to be, that is, underestimation. Indeed, it is assumed that some pulses are lost due to the delayed closure of the switch or to the opening of the switch during the stimulus to be timed (for reviews, see Lejeune, 1998; Coull, Vidal, Nazarian, & Macar, 2004; Penney, Gibbon, & Meck, 2000; Zakay, 2005). This attention-related underestimation of time has been reported in numerous studies that manipulated the level of attention devoted to time processing (Buhusi & Meck, 2005, 2006; Casini & Macar, 1999; Fortin & Tremblay, 2006; Gautier & Droit-Volet, 2002).

Recently, some studies have investigated the effect on time perception of different standardized emotional stimuli, that is, emotional facial expressions (Droit-Volet, Brunot, & Niedenthal, 2004; Effron, Niedenthal, Gil, & Droit-Volet, 2006; Gil, Niedenthal, & Droit-Volet, 2007; Tipples, 2008), emotional sounds (Noulhiane, Mella, Samson, Ragot, & Pouthas, 2007), or emotional pictures taken from the International Affective Picture System (Angrilli, Cheru-
bini, Pavese, & Manfredini, 1997; for a recent review, see Droit-Volet & Meck, 2007, or Droit-Volet & Gil, 2009). However, despite the growing body of studies devoted to emotion and time, only the study conducted by Angrilli et al. (1997) examined the effect on time perception of disliked pictures. In this study, the authors selected pictures for valence (unpleasant or pleasant) and for arousal (high or low), and the participants were required to estimate verbally or to reproduce the durations of these pictures (2, 4, and 6 s). The obtained data were both interesting and complex and revealed an interaction between arousal and the affective valence of the slides. According to the authors, two main mechanisms were involved in the effect of the emotional pictures on their participants’ time estimation. In the case of low-arousal stimuli, they considered that attentional control processes were involved, and in particular in the case of negative valence, for example, pictures of a rat in the dirt. Indeed, they imagined that an examination of the content of the picture would distract attention away from the processing of temporal information. In contrast, in the case of the high-arousal emotional stimuli, an “emotion-driven mechanism” would be involved, and would be so to a greater extent for pictures of negative valence than for those of positive valence. They explained this phenomenon in terms of a motivational–survival system for high arousal, with people processing potentially dangerous stimuli quickly and automatically.

However, in each category of emotional pictures tested by Angrilli et al. (1997)—unpleasant/high arousal, unpleasant/low arousal, pleasant/high arousal, pleasant/low arousal—the discrete emotion elicited by each of the pictures was not specified. Moreover, a recent study (Mikels et al., 2005) has revealed that three slides used by the authors represented mutilations eliciting disgust: (a) a baby with eye tumor, (b) a smashed face, and (c) a dead cut body. Consequently, these three pictures of mutilated bodies produced an overestimation of time because they were highly arousing. However, it is generally accepted that the basic function of disgust (literally, “bad taste”) in humans is to cause them to reject bad food (Rozin & Fallon, 1987): “The term ‘disgust,’ in its simplest sense, means something offensive to the taste. It is curious how readily this feeling is excited by anything unusual in the appearance, or nature of our food” (Darwin, 1872/1998, p. 255). Consequently, we may suppose that the effect of disgust on time perception will differ as a function of the stimuli eliciting this emotion: a mutilated body or disgusting food. However, disliked food may provoke a lower level of arousal than mutilation pictures.

The present study was thus the first to test the effect on time perception of perceiving pictures of foods judged to be either disgusting or pleasant. We consequently tested the arousal and valence values of the food pictures used by Rousset, Deiss, Julliard, Schlich, and Droit-Volet (2005) and Rousset, Schlich, Chatonnier, Barthomeuf, and Droit-Volet (2008). The participants then performed a temporal bisection task that is commonly used to test the predictions of scalar timing theory in animals (e.g., Church & Deluty, 1977; Santi, Miki, Hornyak, & Eidse, 2005), as well as in adults and children (e.g., Droit-Volet, Clément, & Fayol, 2003; Droit-Volet, Meck, & Penney, 2007; Wearden, 1991). In this task, the participants were first presented with a short and a long standard duration. They were then required to determine whether the probe durations presented in the form of food pictures were more similar to the short or to the long standard. As there was no picture of a neutral food item (see Procedure), we decided to present the participants with two successive bisection tasks, one using a neutral stimulus (no-food temporal bisection task), and another using emotional food pictures (liked and disliked foods). Moreover, to control for interpersonal differences in sensitivity to disgust, the participants responded to the 32-item Disgust Scale (Haidt, McCauley, & Rozin, 1994).

Method

Participants

The participants consisted of 63 healthy French adults: 31 men (mean age = 25.42 years; SD = 0.58) and 32 women (mean age = 24.47 years; SD = 0.48), recruited by local newspaper advertisements. They received 10 euros for their participation.

Materials

Each participant was tested individually in a laboratory at Blaise Pascal University, Clermont-Ferrand, France. A Power Macintosh computer controlled the stimulus presentation and recorded the data using PsyScope software. The participants responded by pressing one of two keys on the computer keyboard (K or D). There were two types of stimuli: (a) the food pictures, and (b) the neutral picture. The food pictures consisted of two kinds of emotion-inducing food, one judged as eliciting disgust and the other as eliciting pleasure, presented on a plate (see Figure 1).

These foods were chosen on the basis of two pretests: (a) a test measuring the intensity of emotion elicited by the food: disgust, pleasure, and neutrality; and (b) a test of both the level of arousal provoked by these food pictures as well as their affective valence. First, emotional food pictures were selected from a set of 15 different food pictures on the basis of the results obtained in the first pretest, which was performed by 74 additional subjects (mean age = 26.6 years, SD = 4.0). These participants had to imagine consuming the food item and judge the intensity of three emotions (disgust, pleasure, and neutrality) on a 7-point scale from 0 (I do not feel it) to 6 (I feel it very strongly). Three liked food pictures were thus selected: cream cake, dark chocolate, and French bread. Similarly, 3 disliked food pictures were selected: blood sausage, beef sausage with vegetables, and dried beef sausage. Table 1 presents the emotion-inducing picture evaluations according to this first pretest. Second, 26 further additional participants (mean age = 18.5 years, SD = 0.76) performed two dimensions (pleasure and arousal) of the Self-Assessment Manikin scale (Lang, 1980). This affective rating system uses 9-point scales consisting of graphic illustrations to indicate how the subject feels while viewing the picture. The participants were presented with the 6 selected food pictures among 24 other pictures from the International Affective Picture System. These pictures were chosen to permit the presentation of an equal number of both negative and positive pictures and of high- and low-arousal pictures. Therefore, for each picture, the participants responded on two scales: one for the arousal dimension (from a sleepy to an excited figure) and the other for the valence dimension (from a frowning to a happy figure). The order of the scales was counterbalanced across the pictures and participants, and the presentation of the pictures was randomized. Table 2 shows the arousal and valence evaluations for the food pictures (the disliked and liked ones) and for the no-food picture (neutral).
pictures (for the high- and the low-arousal pictures and for the negative and positive pictures, respectively). Table 3 shows the evaluation of arousal and valence for the 6 food pictures independently. As expected, the results of this pretest showed that all the food pictures were low arousal (mean <4 on a 9-point scale), although these evaluations were significantly different from 0, both the disliked pictures, $t(25) = 9.11, p < .001$, and the liked pictures, $t(25) = 11.49, p < .001$. Moreover, it can be seen that arousal was higher for the positive ($M = 3.96$, $SD = 1.71$) than for the negative food pictures ($M = 2.91$, $SD = 1.63$), $t(25) = -2.37$, $p < .001$. In addition, the results for valence were consistent with the first pretest evaluation of disgust and pleasure. Indeed, the mean valence of the food pictures evaluated as pleasant was clearly higher than 5 ($M = 6.5$, $SD = 1.50$), whereas that of the food pictures evaluated as disliked was lower than 5 ($M = 3.5$, $SD = 1.23$), these two valences being significantly different, $t(25) = -9.73, p < .001$.

The neutral stimulus consisted of a picture of a white oval with similar perceptual characteristics to the plate used in the food pictures, for example, same color (white) and same size ($20 \times 14$ cm). The decision to present this white oval as the neutral stimulus was the result of our pretest showing that food pictures were not evaluated as neutral, but always elicited an emotion. In addition, to enable us to assess a general sensitivity to disgust, the participants responded to the Disgust Scale (Haidt et al., 1994), which takes the form of a 32-item self-rating questionnaire.

Procedure

The participants were told not to eat anything for 1 hr before the testing session. They then performed two successive temporal bisection tasks (nonfood vs. food), with the order of these tasks counterbalanced across the participants. The participants then completed the Disgust Scale.

Each bisection task consisted of two phases: a training and a testing phase. During the training phase, the participants were initially presented with a short (400 ms) and a long (1,600 ms) standard duration in the form of the white oval. This oval was presented in a random order for 10 trials (5 short and 5 long). In this way, the participants were trained to press one of two keys to indicate whether the stimulus corresponded to the short standard ($K$) or the long standard ($D$). The response keys were counterbalanced across participants. The intertrial interval was a random interval of between 1 and 2 s.

In the testing phase, the participants had to perform the same task, that is, to indicate whether the presentation duration was similar to the short or to the long standard duration. However, whereas the stimuli took the form of a white oval in the no-food bisection task, food pictures were used in the food bisection task. In addition, the stimuli were presented using seven probe durations: the two standards (400 and 1,600 ms), and five intermediate duration values (600, 800, 1,000, 1,200, and 1,400 ms). In the no-food bisection task, each participant completed 63 trials, that is, 9 trials for each probe duration ($9 \times 7$), and in the food bisection task 126 trials, that is, 9 trials for each probe duration and for the two kinds of emotional stimuli (disliked and liked food pictures: $9 \times 7 \times 2$). In the two bisection tasks, the trials were presented in a random order.

Results

The initial statistical analyses revealed no significant correlations between the individual scores for sensitivity to disgust and the three temporal indexes used in the subsequent analyses. We therefore did not use this factor as a covariate in the following analyses of variance (ANOVA).

Figure 2 indicates the proportion of long responses plotted against probe durations. An examination of this figure suggests that the psychophysical functions are shifted toward the right for both types of food stimuli (disliked and liked) compared with those for the neutral stimulus. The statistical analyses confirmed this impression. An ANOVA was conducted on the proportion of long responses with durations (400, 600, 800, 1,000, 1,200, 1,400, and 1,600 ms) and emotional stimuli (nonfood, disliked food, liked food) as within-subjects factors and sex as a between-subjects factor. This ANOVA showed a

<table>
<thead>
<tr>
<th>Picture</th>
<th>Disgust $M$</th>
<th>Disgust $SD$</th>
<th>Pleasure $M$</th>
<th>Pleasure $SD$</th>
<th>Neutrality $M$</th>
<th>Neutrality $SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cream cake</td>
<td>0.65</td>
<td>1.33</td>
<td>4.12</td>
<td>1.74</td>
<td>1.91</td>
<td>1.82</td>
</tr>
<tr>
<td>Dark chocolate</td>
<td>0.82</td>
<td>1.51</td>
<td>3.53</td>
<td>1.88</td>
<td>2.19</td>
<td>2.01</td>
</tr>
<tr>
<td>French bread</td>
<td>0.66</td>
<td>1.33</td>
<td>3.38</td>
<td>1.78</td>
<td>2.57</td>
<td>1.95</td>
</tr>
<tr>
<td>Blood sausage</td>
<td>3.32</td>
<td>2.19</td>
<td>1.44</td>
<td>1.72</td>
<td>1.73</td>
<td>1.91</td>
</tr>
<tr>
<td>Beef sausage with vegetables</td>
<td>3.15</td>
<td>2.16</td>
<td>1.19</td>
<td>1.40</td>
<td>1.97</td>
<td>1.71</td>
</tr>
<tr>
<td>Dried beef sausage</td>
<td>2.97</td>
<td>1.97</td>
<td>1.87</td>
<td>2.19</td>
<td>2.43</td>
<td>1.89</td>
</tr>
</tbody>
</table>

459 EMOTIONS, FOOD, AND TIME PERCEPTION

Table 1

Means and Standard Deviations for Evaluations of Six Emotional Food Pictures of Disgust, Neutrality, and Pleasure (7-Point Scale)
main effect of duration, $F(6, 366) = 900.03, p < .001$, thus indicating that the subjects estimated time accurately, that is, the longer the stimulus was, the more likely the participants were to respond “long.” There was also a main effect of emotional stimulus, $F(2, 122) = 13.18, p < .001$, and an interaction between duration and emotional stimulus, $F(12, 732) = 9.09, p < .001$. These latter results reveal that time estimations varied between the types of emotion and as a function of stimulus duration. Neither sex, $F(1, 61) = .004, p = .95$, nor any of the other interactions was significant.

To examine differences in time performance as a function of the evoked emotion, we conducted a series of ANOVAs on the proportion of long responses in order to perform a pairwise comparison between the emotional conditions. In the case of disliked foods compared with the neutral stimulus, the results revealed an effect of duration, $F(6, 366) = 812.18, p < .001$, and of emotional stimulus, $F(1, 61) = 16.37, p < .001$, as well as an interaction between the duration and emotional stimulus, $F(6, 366) = 8.30, p < .001$. For the liked foods compared with the neutral stimulus, there was also an effect of duration, $F(6, 366) = 856.17, p < .001$, an effect of emotional stimulus, $F(1, 61) = 11.82, p < .001$, and a Duration × Emotional Stimulus interaction, $F(6, 366) = 10.44, p < .001$. The significant effect of emotional stimulus in these two statistical analyses indicated that both disliked food pictures ($M = 0.54$) and liked food pictures ($M = 0.55$) were underestimated compared with the neutral no-food picture ($M = 0.60$). The significant interaction revealed that the extent to which food pictures were underestimated varied with stimulus duration. Indeed, as Figure 2 shows, the underestimation appeared to be larger in the middle of the stimulus duration (800, 1,000, and 1,200 ms). The ANOVA comparing the two kinds of food also revealed a main effect of duration, $F(6, 366) = 626.41, p < .001$, and a significant Duration × Emotional Stimulus interaction, $F(6, 366) = 7.97, p < .001$, but no main effect of emotional stimulus, $F(1, 61) = 2.41, p = .13$. These latter results indicate that the difference between the disliked and the liked food pictures varied as a function of the duration of the stimulus presentation.

To further explore the time differences between our experimental conditions, we decided to calculate two indexes used in bisection studies. The first was the bisection point (BP). This is the point of subjective equality, that is, the stimulus duration at which the participants responded “short” or “long” with equal frequency ($p_{\text{[long]}} = 0.5$). The second was the Weber ratio (WR). This is the ratio between the difference limen (i.e., half the difference between the stimulus duration giving rise to a $p_{\text{[long]}} = 0.75$ and that giving rise to a $p_{\text{[long]}} = 0.25$) and the BP. It acts as an index of time sensitivity: The higher the WR, the steeper the slope of the bisection function, and the higher the sensitivity to time. These two indexes were calculated on the basis of the resulting slope and intercept of a linear regression performed on the steepest part of each individual bisection function (for a more detailed explanation, see Droit-Volet & Wearden, 2002; Wearden & Ferrara, 1996). Table 4 shows the BP and WR means for each emotional stimulus. The BP was close to the geometric mean of the short and long standard duration (e.g., 800 ms) for the no-food condition, consistent with scalar timing theory (Allan & Gibbon, 1991; Meck, 1983). The results of the analyses conducted on these two indexes were consistent with those found on the proportion of long responses. Indeed, in the case of the BP, the overall ANOVA revealed a main effect of emotional stimulus, $F(2, 122) = 7.28, p < .001$. Paired-sample t tests indicated that BP values were significantly higher for the disliked foods than for the no-food stimulus, $t(62) = -3.40, p < .001$, and tended to be significantly higher for the liked foods than for the no-food stimulus, $t(62) = -1.82, p = .07$. Moreover, the BP value was significantly higher for the disliked than for the liked foods, $t(62) = 2.41, p < .05$. This horizontal rightward shift of the BP showed that not only was the duration of food pictures underestimated compared with that of a nonfood picture, but also that the magnitude of this underestimation was greater for the disliked than for the liked foods. The overall ANOVA conducted on the WR revealed no effect of emotional stimulus, $F(2, 122) = .34, p = .71$, indicating that sensitivity to time was

### Table 2

**Means and Standard Deviations for Evaluations of Arousal and Valence Elicited by Food Pictures and No-Food Pictures From the Self-Assessment Manikin Scale (9-Point Scale)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Disliked</th>
<th>Liked</th>
<th>Disliked</th>
<th>Liked</th>
<th>Disliked</th>
<th>Liked</th>
<th>Disliked</th>
<th>Liked</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arousal</td>
<td>2.91</td>
<td>1.63</td>
<td>3.86</td>
<td>1.71</td>
<td>7.08</td>
<td>1.96</td>
<td>5.87</td>
<td>1.61</td>
</tr>
<tr>
<td>Valence</td>
<td>3.50</td>
<td>1.23</td>
<td>6.05</td>
<td>1.50</td>
<td>1.49</td>
<td>.75</td>
<td>6.41</td>
<td>1.13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 3

**Means and Standard Deviations for Evaluations of Six Emotional Food Pictures Used for Arousal and Valence Dimensions From the Self-Assessment Manikin Scale (9-Point Scale)**

<table>
<thead>
<tr>
<th>Picture</th>
<th>Arousal</th>
<th>Pleasure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Cream cake</td>
<td>4.35</td>
<td>1.92</td>
</tr>
<tr>
<td>Dark chocolate</td>
<td>4.04</td>
<td>2.51</td>
</tr>
<tr>
<td>French bread</td>
<td>3.19</td>
<td>1.92</td>
</tr>
<tr>
<td>Blood sausage</td>
<td>2.50</td>
<td>2.16</td>
</tr>
<tr>
<td>Beef sausage with vegetables</td>
<td>2.54</td>
<td>1.79</td>
</tr>
<tr>
<td>Dried beef sausage</td>
<td>3.69</td>
<td>2.22</td>
</tr>
</tbody>
</table>
similar for the different kind of pictures used, that is, whether
with or without food.

Discussion

In the present study, the effect of an emotional stimulus on time
perception depended on the specific meaning of this stimulus for
the participant. The participants tended to categorize the presen-
tation durations of the food pictures as shorter than those of the
nonfood pictures irrespective of the type of food presented. Indeed,
our results showed that the proportion of long responses was
significantly lower and the BP higher for the food pictures than for
the nonfood pictures. As set out in the introduction, this temporal
shortening effect should be explainable, within the framework of
the information-processing model, in terms of an attentional-bias
hypothesis. When individuals’ attention is distracted away from
the processing of time, either the switch closing latency is delayed
or the switch does not remain closed. Given that time estimation
is based on the quantity of pulses entering the accumulator via
the switch, a loss of pulses produces a relative temporal underestima-
tion (e.g., Macar, Grondin, & Casini, 1994; Zakay & Block, 2004).
Within this framework, we can therefore assume that the shorten-
ing effect obtained with food pictures in our study was due to an
attentional mechanism because the food pictures distracted more

![Figure 2. Proportion of long responses (p(long)) plotted against stimulus duration for the neutral stimulus, the
liked food pictures, and the disliked food pictures.](image)

attention away from the processing of time than the neutral picture
did.

The most interesting finding of our study is that the magnitude
of this shortening effect was greater for the disliked than for the
liked food pictures. The greater temporal underestimation ob-
served on disliked food pictures is consistent with the main origi-
nal function of the emotion of disgust. According to Darwin’s
evolutionary perspective, the fundamental function of disgust is
related to a health protection mechanism. Indeed, the disgust
response should allow us to avoid the consumption of something
that is potentially dangerous to health. Consequently, it is not
surprising that disliked food pictures capture more attentional
resources than pictures of liked foods. Because disliked foods
represent a potentially greater danger to health, individuals must
consider these foods more attentively. Cognitive appraisals are
clearly essential if we are to accept or reject substances. As Rozin
and Fallon (1987) have suggested, the emotion of disgust is pre-
cisely generated by these appraisals.

As suggested by psychologists studying discrete emotions
within the framework of a motivational system (Bradley,
Codispoti, Cuthbert, & Lang, 2001; Bradley, Codispoti, Sabati-
nelli, & Lang, 2001; Lang, 1995), emotions constitute a source of
action disposition, which can help people to adapt their behavior
and cope with the environment (Frijda, 1986; Keltner & Haidt,
2001; LeDoux, 1996). Consequently, our findings suggest that
emotional stimuli eliciting the same emotion (disgust) produce
different time distortions as a function of the significance of the
stimulus in question for human beings. When the pictures repre-
sent mutilated bodies, as in the Angrilli et al. (1997) study, they
produce a temporal overestimation, and when the pictures repre-
sent disliked foods, as in our study, they produce a temporal
underestimation.

In line with Angrilli et al. (1997), we may also suggest that for
one and the same elicited emotion, it is the level of arousal that
triggers the type of mechanism involved in the processing of an
emotional stimulus and the associated direction of time distortion.

Table 4

<table>
<thead>
<tr>
<th>Picture</th>
<th>Bisection point (M)</th>
<th>Bisection point (SD)</th>
<th>Weber ratio M</th>
<th>Weber ratio SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>No food</td>
<td>865.90</td>
<td>140.02</td>
<td>.23</td>
<td>.05</td>
</tr>
<tr>
<td>Liked foods</td>
<td>904.05</td>
<td>129.39</td>
<td>.23</td>
<td>.04</td>
</tr>
<tr>
<td>Disliked foods</td>
<td>943.66</td>
<td>183.01</td>
<td>.23</td>
<td>.05</td>
</tr>
</tbody>
</table>
Indeed, in our study, the stimuli that provoked disgust were evaluated as low-arousal stimuli using the Self-Assessment Manikin scale. In contrast, in the Angrilli et al. study, the stimuli that generated disgust were evaluated as high-arousal stimuli using the same test. When low-arousal emotional stimuli are involved, we can assume that attentional processes predominate because the situation is not urgent and therefore requires attentional control rather than immediate readiness for action. In contrast, when the emotional stimuli provoke a high level of arousal, they trigger an autonomic nervous system activity, for example, blood pressure, pupil dilation, and muscle contraction, which prepares the organism to react as quickly as possible. This activity is presumably associated with a speeding up of the clock (Droit-Volet & Meck, 2007). Consequently, when the internal clock runs faster than normal, time passes faster, and the individual is ready to produce an action earlier, for example, to give immediate first aid to an accident victim. This is consistent with the results of studies showing that the perception of angry or fearful facial expressions or of threatening situations produces a temporal overestimation due to the increase of arousal that speeds up the internal clock (Droit-Volet et al., 2004; Droit-Volet & Gil, 2009; Gil & Droit-Volet, submitted; Gil et al., 2007; Meck, 1996; Thayer & Schiff, 1975).

In conclusion, our study provides new findings about the emotion of disgust, that is, the protection against potentially dangerous oral ingestion, thus indicating that time seems to fly when individuals are confronted with food items and, to a greater extent, when faced with disliked food items. This attention-related shortening effect provides new evidence that the impact of emotions on time perception cannot be explained simply in terms of an exclusive arousal mechanism. Indeed, the emotion-related effect on time perception appears to depend to a great extent on the adaptive meaning of the emotional stimulus. In addition, within a clinical perspective aimed at obtaining a better understanding of eating disorders, it would be interesting to extend the study of disturbances in temporal perception associated with emotions elicited by foods.

References
Lejeune, H. (1998). Switching or gating? The attentional challenge in...


