

The Timing of Appraisals

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The appraisal process consists of the subjective evaluation that occurs during an individual's encounter with significant events in the environment, determining the nature of the emotional reaction and experience. Placed in the context of appraisal theories of emotion-elicitation and differentiation, the aim of the present research was to test empirically the hypothesis that the intrinsic pleasantness evaluation occurs before the goal conduciveness evaluation. In two studies, intrinsically pleasant and unpleasant images were used to manipulate pleasantness, and a specific event in a Pacman-type videogame was used to manipulate goal conduciveness. Facial EMG was used to measure facial reactions to each evaluation. As predicted, facial reactions to the intrinsic pleasantness manipulation were faster than facial reactions to the goal conduciveness manipulation. These results provide good empirical support for the sequential nature of the appraisal process.

Keywords: appraisal theory, facial expressions, facial electromyography

Appraisal theories of emotion (for a review see Scherer, 2001) claim that emotions are elicited and differentiated by conscious or unconscious evaluations of events and situations. Although different appraisal theories vary with regard to both the number of appraisal categories they include and the exact definition of these categories, there is substantial overlap. Scherer (1999a) categorizes proposed appraisals into four classes: appraisals related (1) to the intrinsic properties of the stimulus, such as novelty and pleasantness; (2) to the significance of the event for the individual's needs and goals; (3) to the individual's ability to cope with the consequences of an event; and (4) to the compatibility of the event with social and personal norms and values.

According to appraisal theory, it is the subjective evaluation of an event as pleasant or unpleasant, conducive, or unconducive to one's goals, as changeable or not, and as compatible or incompatible with social and personal norms that entrains the emotion that is experienced. Thus, an event that is appraised as pleasant and goal conducive elicits joy, whereas one that is appraised as goal obstructive and as difficult or impossible to redress elicits sadness. It is important to note that appraisals typically are immediate, intuitive, direct, and largely outside awareness (Arnold, 1960; see also Kappas, 2001). That is, they are not typically the product of reasoning processes, even though people can and do reconstruct appraisal processes consciously after the fact (e.g., Robinson & Clore, 2001).

Appraisal theories differ with regard to the exact process of appraisals. Whereas some theorists explicitly assume that specific appraisals are conducted in a flexible order within repeated cycles of the appraisal process (e.g., Smith & Lazarus, 1993), others

maintain that some (e.g., Ellsworth, 1991) or all (Scherer, 1987, 2001) appraisals follow a fixed order. In particular, appraisals of novelty and intrinsic pleasantness should precede appraisals of goal conduciveness (Ellsworth, 1991; Scherer, 1987, 2001). The goal of the present research was to test this hypothesis empirically.

In this context, intrinsic pleasantness is defined as an evaluation of whether a stimulus is likely to result in pleasure or displeasure. Goal conduciveness in contrast is defined as the evaluation of whether the stimulus event is likely to help or hinder the attainment of one's goals. Although some theories (e.g., Smith & Lazarus, 1990) conflate these two appraisals, they are differentiated in Scherer's (2001) Sequential Check Theory of Emotion Differentiation by the fact that intrinsic pleasantness is a characteristic of the stimulus and independent of the goals of the organism, whereas goal conduciveness depends directly on the organism's motivational state. Thus, eating chocolate will be pleasant whether or not one is on a diet, but in the former case it is not goal conducive. In fact, based on a multiprocess approach to appraisal theory, it can be argued that the valence detection, which is central to the intrinsic pleasantness appraisal, is most likely an automatic, preattentive process (see Robinson, 1998, for a detailed account of this notion), whereas the goal conduciveness appraisal requires some level of conceptual processing. Because conceptual processing requires attention, this latter appraisal needs to temporarily follow the former. Yet, because these cognitive processes can be expected to occur very rapidly indeed, the question arises how to assess this proposed time difference between the two appraisals.

In an ingenious experiment, Scherer (1999b) used an indirect approach. Specifically, in three experiments participants were presented with information regarding an emotion-eliciting situation. The participants' task was to select the correct emotion in a reaction time task. The information was presented either in an order corresponding with the predicted sequence of appraisals according to the Sequential Check Theory of Emotion Differentiation or in a random order. The combined results from the three experiments suggest that emotion recognition is more accurate and more rapid when the appraisal relevant information is presented in

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the predicted order than when presented in a random order. Furthermore, by using an approach similar to the one described below in a memory task, Aue, Flykt, and Scherer (2005) were able to demonstrate the sequential occurrence of the goal relevance and goal conduciveness checks.

Specifically, recent research has started to focus on the physiological and expressive correlates of emotion (van Reekum, Johnstone, & Banse, 2004; Kappas & Pecchinenda, 2000), which offer a more direct approach to assess the timing of appraisals. In particular, several appraisal theories have made specific proposals regarding the link between certain appraisals and facial behavior. Thus, empirical evidence links action of the *Corrugator Supercilii* muscle (frown) has been linked to feelings of unpleasantness (see Cacioppo, Martzke, Petty, & Tassinary, 1988), as well as to goal obstruction (Smith & Scott, 1997). In contrast, activity of the *Zygomaticus Major* (smile) has been shown to be linked to intrinsic pleasantness (see Cacioppo et al., 1988). Scherer (2001) presents a series of predictions linking facial actions as described by the Facial Action Coding System (FACS, Ekman & Friesen, 1978) to appraisals. Specifically, he predicts that both unpleasantness and goal obstructions should entrain AU4 (*Corrugator Supercilii* activity, frown), whereas both pleasantness and goal conduciveness should entrain activation of AU6 (*Orbicularis Oculi* activity that produces wrinkles around the eye) and AU12 (*Zygomaticus Major* activity, smile). The fact that both types of appraisals entrain activity of the same muscle makes it possible to use facial EMG to assess differences in timing between the two appraisals. Specifically, facial EMG measures the electrical activity of muscles as they contract. It does not measure the nerve impulse, however; hence differences in latency across different muscles may be attributable to differences related to muscle physiology rather than to the timing of the cortical signal. This problem is resolved when timing of the same muscle in response to different elicitors is compared. Thus, when *Corrugator Supercilii* contracts as a function of an unpleasantness evaluation, it should do so faster than when it contracts as a function of a goal obstruction. Conversely, activation of *Zygomaticus Major* and *Orbicularis Oculi* should be faster when their activation is because of a pleasantness evaluation than to a goal conduciveness evaluation.

Study 1

Study 1 was designed to assess the hypothesis that the intrinsic pleasantness evaluation occurs before the goal conduciveness evaluation. We predicted that the onset of *Corrugator Supercilii* would be faster in response to the intrinsic pleasantness evaluation of a negative image than in response to the evaluation of an event that is not goal conducive, whereas the onset of *Orbicularis Oculi* and *Zygomaticus Major* would be faster in response to the intrinsic pleasantness evaluation of a positive image than for the evaluation of an event that is goal conducive. To assure that differences in the speed of the cognitive treatment of the stimuli per se would not bias the findings, both valence and goal conduciveness information was presented in the form of images.

Method

Participants

Seventy-eight adults (39 women; mean age = 24 years, $SD = 4.7$) volunteered to participate in this study. Participants were

undergraduate students at the University of Quebec at Montreal and were recruited through flyers and campus-wide announcements.

Materials

Video game. A Pacman-type videogame was created. The purpose of this videogame is to travel through a maze while “eating” small tokens to obtain points and avoiding the snakes that want to “kill” the Pacman. The goal is to obtain as many points as possible before all lives are lost. Winning a life was considered goal conducive and losing a life was goal obstructive.

Images. A total of 28 images were used to manipulate intrinsic pleasantness. Two sets of images were created, one for each game. The first set consisted of 14 neutral images (kitchen articles and living room furniture). The second set consisted of seven intrinsically pleasant images illustrating baby animals and seven intrinsically unpleasant images representing human injuries. Images were chosen after being evaluated for their emotional valence and arousal using the Affect grid (Russell, 1980). Images with a positive valence were associated with a positive consequence in the videogame (winning a life) and images with a negative valence were associated with a negative consequence in the video game (losing a life). As for neutral images, kitchen articles were associated with a negative consequence and images of living room furniture were associated with a positive consequence. Images appeared randomly and at random intervals during the videogame.

Dependent Measures

Facial EMG was used to measure facial expressive reactions to the game situations. Activity of the *Orbicularis Oculi*, *Zygomaticus Major*, *Corrugator*, and *Supercilii* was measured on the right side of the face by using bipolar placements of Med Associates Inc. Ag/AgCl miniature surface electrodes with Med Associates Inc. electrolyte gel (TD41; St. Albans, VT). The skin was cleaned with Professional Disposables Inc. disposable electrode prep pads (70% alcohol and pumice). Electrode placements were chosen according to Fridlund and Cacioppo (1986). A Contact Precision Instruments (London) system with 60-Hz notch filter was used to amplify the raw EMG signal. The raw EMG signal was sampled at 100 Hz and stored to disk. To assess the onset of the muscle activity, a custom program was used to establish a threshold for onsets based on an algorithm for pause detection developed by Hess (1973). First, noise needed to be distinguished from signal. For this, a frequency analysis was conducted. Noise is defined as small amplitude values that occur frequently. Once threshold was defined as values larger than noise values, the program checked the rectified data file for the first series of 5 consecutive points above threshold. The first of these points was defined as onset. A visual inspection of the program results was conducted, and “false onsets” (e.g., a “blip” with 6 data points) were rejected. This analysis was conducted separately for all three muscles.

Procedure

Participants first played a practice Pacman game without seeing any images. The practice game was used to allow participants to be more familiar with the videogame and to get used to the electrodes.

An initial habituation phase, designed to accustom participants to the presentation of an image during the course of the game, was then presented to the participants. This videogame contained neutral images (landscapes) that were not used for the experiment proper. The participants then played a game containing the neutral images (kitchen articles and living room furniture) associated with positive and negative consequences in the videogame. Finally, participants played a videogame containing pleasant and unpleasant images followed by positive and negative consequences. Before starting to play, participants were told that if they obtained 6000 points at the videogame, they would receive a gift.

Results

To test the hypothesis that the intrinsic pleasantness evaluation temporarily precedes the goal conduciveness evaluation, a *t* test was performed to compare muscle reactions onsets as a function of the type of evaluation. The onset for the facial reaction to the neutral image signaling receipt or loss of a life was established as the onset for the goal conduciveness evaluation and the onset for the facial reaction to the pleasant and unpleasant images determined the onset time for the intrinsic pleasantness evaluation. Across muscles, the mean onset time for the intrinsic pleasantness evaluation ($M = 424.33$, $SD = 28.89$) was significantly shorter than the mean onset time for the goal conduciveness evaluation ($M = 811.40$, $SD = 23.64$), $t(73) = -99.87$, $p < .001$. The mean response times for each muscle region to both types of evaluations are presented in Figure 1. As predicted, the facial reactions to the pleasantness manipulation preceded the facial reactions to the goal conduciveness manipulation.

Discussion

In summary, the results from Study 1 support the notion that intrinsic pleasantness is evaluated prior to goal conduciveness. Specifically, *Corrugator Supercilii* activity in reaction to unpleasant images as well as *Orbicularis Oculi* and *Zygomaticus Major* activity in reaction to pleasant images was faster than the activation of the same muscles in response to a signal that indicated a goal obstructive versus a goal conducive event as predicted by Scherer's (2001) Sequential Check Theory of Emotion Differentiation.

However, it could be argued that we compared two different situations. Thus, to assess onset times for the pleasantness evaluation we measured the participant's facial reaction to the image. Yet, to assess facial muscle activity in response to the goal conduciveness evaluation, we assessed reactions to symbolic information (kitchen objects vs. living room objects signaling gains and losses of lives respectively). Thus, it may be argued that the delay between the two is caused because participants did initially not react to the neutral stimulus because they had to decode an abstract signal. Specifically, they had to first categorize the objects shown in the neutral images into their respective object category, and this requires access to memory about kitchen and living room objects. In contrast, Zajonc (1980, 1984) has claimed that the valence information related to an object is immediately available and does not require cognitive treatment. Although this view has been critiqued (see Leventhal & Scherer, 1987, for a summary of this discussion), it still may be argued that valence information can be more rapidly extracted from a stimulus than the categorization into objects properly belonging in the kitchen and those properly be-

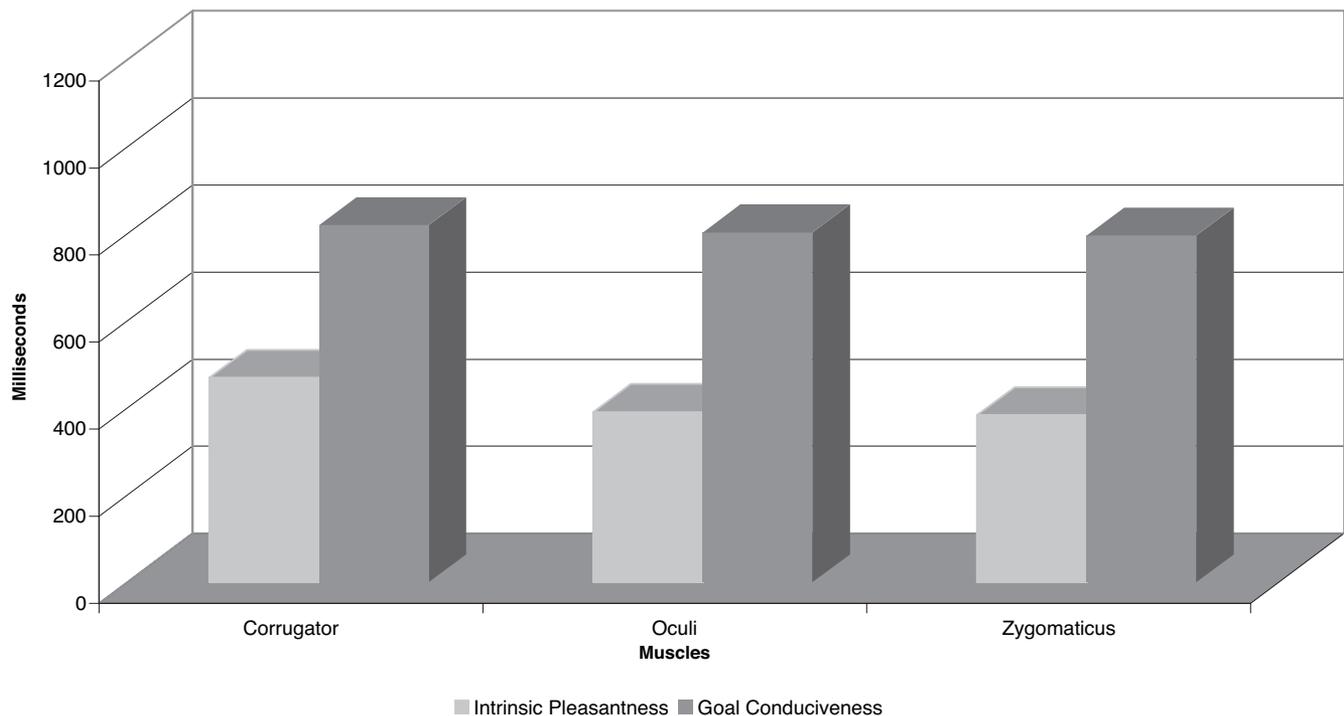


Figure 1. Mean onset time as a function of muscle site and evaluation type (Study 1).

longing in the living room and that the observed difference in facial reactions was because of this processing difference. That is, one may posit that once an object is identified as a kitten, its valence information does not have to be separately retrieved. In contrast, one may conceivably argue that once a pot has been identified as a pot, the fact that it belongs to the class of kitchen objects would additionally have to be retrieved.

Study 2 was conducted to address this issue. Specifically, for Study 2, valence information served to signal goal conduciveness as well. For this, a positively valenced image was associated with a negative consequence, whereas a negatively valenced image was predictive of a positive consequence. Hence, only valence information needed to be accessed and no additional classifications unrelated to the goal conduciveness appraisal were necessary for the task.

Study 2

Method

The procedure for Study 2 was exactly the same as Study 1, except for the pairing of the images and the consequences. In this study, unpleasant images were associated with positive consequences (gain of a life) and pleasant images were associated with negative consequences (loss of a life).

Participants

Seventy-eight adults (39 women; mean age = 26 years, $SD = 7.7$) volunteered to participate in this study. Participants were

undergraduate students at the University of Quebec at Montreal, recruited through flyers and campus-wide announcements.

Results

To test the hypothesis that the intrinsic pleasantness evaluation precedes the goal conduciveness evaluation, a t test was performed to compare muscle reactions onsets as a function of the type of evaluation. For pleasant images (which signaled a negative consequence) *Orbicularis Oculi* and *Zygomaticus Major* activity responded to the intrinsic pleasantness evaluation, whereas *Corrugator Supercilii* activity responded to the goal conduciveness evaluation. Conversely, for unpleasant images *Orbicularis Oculi* and *Zygomaticus Major* activity responded to goal conduciveness evaluation, whereas *Corrugator Supercilii* activity responded to the intrinsic pleasantness evaluation

Across muscles, the mean reaction time for facial reactions to the intrinsic pleasantness evaluation ($M = 706.45$, $SD = 31.89$) was significantly shorter than the mean reaction time for facial reactions to the goal conduciveness evaluation ($M = 1046.44$, $SD = 31.26$), $t(76) = -7.176$, $p < .001$. The mean response times for each muscle region to both types of evaluations are presented in Figure 2. As predicted, the evaluation of intrinsic pleasantness precedes the goal conduciveness evaluation. This can be interpreted as evidence that the intrinsic pleasantness evaluation is processed earlier than the goal conduciveness evaluation.

Discussion

Again, as in Study 1, results clearly support the prediction that facial reactions to the appraisal of the intrinsic pleasantness of the

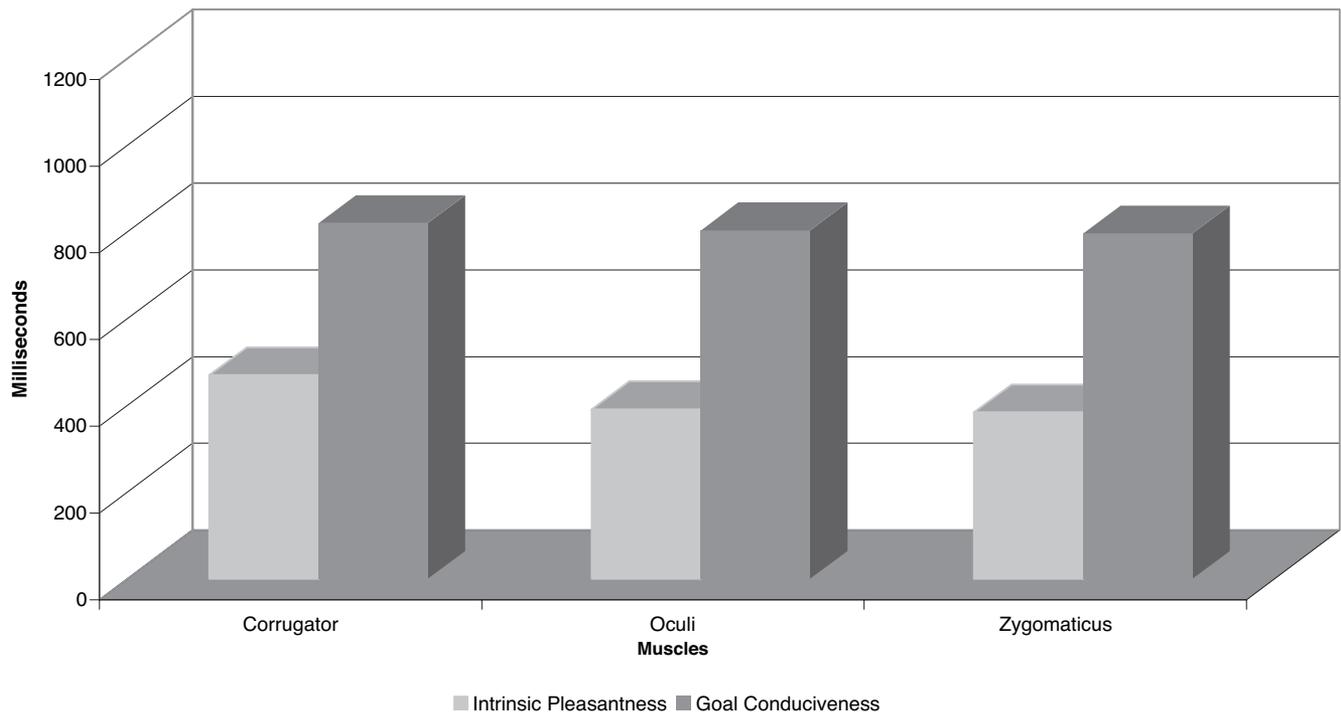


Figure 2. Mean onset time as a function of muscle site and evaluation type (Study 2).

stimulus were faster than facial reactions to the goal conduciveness appraisal. Specifically, the onset of activity of *Corrugator Supercilii* was faster in response to an unpleasant image than in response to a pleasant image that signaled a non-goal-conductive event. Conversely, the onset of *Orbicularis Oculi* and *Zygomaticus Major* activity was faster in response to pleasant images than in response to unpleasant images that signaled a goal-conductive event. Because in this study both pleasantness and goal conduciveness were signaled by valence information, it is unlikely that this difference is because of differences in the cognitive demands implied in the categorization of the signal.

However, we cannot exclude that the difference in reaction time could be explained by Opponent Process Theory (Solomon, 1980; Solomon & Corbit, 1974). Specifically, image valence and image meaning are opposed in emotional significance. Thus, seeing a pleasant image normally results in a positive feeling state, whereas losing points in a game normally results in a negative feeling state. According to opponent process theory, experiencing one emotion should lead to a temporary repression of the opposite emotion. Thus, it is conceivable that the positive/negative feeling state elicited by the images initially suppresses the negative/positive feeling state elicited by the results of the goal conduciveness check. However, it should be noted that the Sequential Check Theory of Emotion Differentiation (Scherer, 2001) does *not* predict facial activation as the result of emotional states, but rather facial activation as directly entrained by appraisal processes. There is no theoretical reason to postulate that appraisal outcomes from different evaluations can suppress each other. Thus, opponent process theory cannot directly explain the present results. However, it may be possible that the contradictory nature of the signaled information resulted in an overall slower reaction, because onset times for all muscles were slower in Study 2 than in Study 1. However, this lengthening in onset times is the same for both evaluations, thus suggesting that the observed differences between onset times reflect underlying differences in the timing of the appraisals.

General Discussion

The goal of the present research was to test specific predictions by the Sequential Check Theory of Emotion Differentiation (Scherer, 2001) regarding the timing of two appraisals: intrinsic pleasantness and goal conduciveness. To test the hypothesis that appraisals of intrinsic pleasantness should precede appraisals of goal conduciveness, we measured the onset of the facial muscle reactions entrained by these appraisal processes. In both studies, results demonstrated that the intrinsic pleasantness evaluation occurs before the goal conduciveness evaluation. Taken together, these studies bring a support to the appraisal theory of emotion, more specifically to the sequential nature of the evaluations. However, the dependent variables in this study are markers of the outcome of the appraisals not of their initiation. That is, when we claim that the intrinsic pleasantness evaluation occurs before the goal conduciveness evaluation, we refer the fact that the results of the intrinsic pleasantness appraisal become available to the emotion process before the results of the goal conduciveness evaluation.

Furthermore, that the timing of facial reactions to intrinsic pleasantness and goal conduciveness appraisals can be dissociated

supports the notion that these two appraisals should be considered separately and not be conflated into one (e.g., Smith & Lazarus, 1990). More specifically, intrinsic pleasantness can be seen as a characteristic of the stimulus, that is, intrinsic pleasantness is essentially independent of the goals of the organism, whereas goal conduciveness depends directly on the organism's motivational state. Also, as mentioned above, valence detection, which is central to the intrinsic pleasantness appraisal is most likely an automatic, preattentive process (Robinson, 1998), whereas the goal conduciveness appraisal requires some level of conceptual processing. Because conceptual processing requires attention, this latter appraisal needs to temporarily follow the former.

In sum, our results clearly support the notion that the intrinsic pleasantness evaluation precedes the goal conduciveness evaluation supporting the predictions of Sequential Check Theory of Emotion Differentiation (Scherer, 2001). Furthermore, this research supports the notion, implicit in several appraisal theories (see Scherer & Ellsworth, 2001), that intrinsic pleasantness and goal conduciveness are separate processes that should not be conflated. Finally, this research illustrated the usefulness of psychophysiological measures for the assessment of an automatic unconscious process.

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