# Time perception of emotional events*

Zhang Xuan[1] and Zhou Xiaolin[1,2,3]**

(1. Department of Psychology, Peking University, Beijing 100871, China; 2. State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing 100875, China; 3. Learning & Cognition Laboratory, Capital Normal University, Beijing 100037, China)

**Abstract** This study investigates whether the accuracy of time perception is influenced by the nature of emotional events and whether time perception has gender differences. Subjects were asked to control the presenting time of pictures of affective facial expressions and to match it with a pre-specified time range. Results showed that (1) compared with the neutral condition, subjects tended to underestimate the time for angry expressions and to overestimate the time for happy expressions; (2) women overestimated the time range much more than men for all the three types of expressions; (3) the size of overestimation steadily decreased over time ranges (0.5—6 sec), and the influence by the affective expressions was observed only at the short time ranges (0.5—2 sec.). These results suggest that time perception of emotional events is varied with emotional valence, and women tend to overestimate all the emotional events.

**Keywords: time perception, emotion, gender differences.**

Humans have been shaped by natural selection and evolutionary force to classify the outside stimulus as hostile or hospitable and to respond accordingly. Affective classification is vital to the survival of our ancestors and it has fundamental impacts upon our perception of the outside world. One possible impact is upon time perception. Anecdotal evidence from different cultures shows that our subjective perception of time can be altered dramatically by the emotional state we are in. The anxious or anguish states make our perceived time being prolonged, such that "one day seems like a year", while time seems to fly quickly when we are in a positive mood. The purpose of this study is to demonstrate the impact of emotional state on time perception. In particular we explore the possible gender differences in the time perception of emotional events since many studies, at both behavioral[1] and neural levels[2], showed that men and women differ dramatically in their experience of emotional stimulus.

Time perception is an important aspect of human cognition. However, it is not clear to what extent time perception can be influenced by the emotional state the perceiver is in. Two previous studies provided contradictory evidence concerning this issue. Angrilli et al.[3] presented affective pictures from International Affective Picture System (IAPS) for different time ranges (2, 4 and 6 sec.) and asked subjects either to judge the presenting time on a continuous scale or to reproduce the time by pressing a response key. Subjects overall underestimated the presenting time for positive and negative pictures, but the intensity and valence of emotional information interacted to affect the accuracy of time perception. Droit-Volet and Wearden[4] presented subjects with pictures of facial expressions (angry, neutral, happy) for various time ranges (400—1600 ms) and asked them to judge whether the presenting time was closer to 400 ms or 1600 ms. Results showed that subjects tended to classify the perceived time duration as closer to 1600 ms, but these overestimations did not differ between happy and angry expressions. These two studies, however, may have suffered from methodological drawbacks. The emotional stimulus was presented before the subject carried out the time estimation task. It is possible that when the subject performed the task, his emotional arousal by the stimulus had already decreased, producing less impact on time perception.

Moreover, the forced choice task may be not sensitive enough to reflect the influence of mood on time perception. Furthermore, the two studies considered respectively the perception of short (within 2 seconds) and longer (2—6 seconds) time periods whereas it is possible that the perception of short and longer times is affected differentially by physical arousal and the distribution of attentional re-

* Supported by China National Pandeng Project (95-special-09), National Natural Science Foundation of China (Grant Nos. 30070260, 30470569, 60435010) and Beijing Key Laboratory of Learning and Cognition, Capital Normal University

** To whom correspondence should be addressed. E-mail: xz104@pku.edu.cn

sources[5]. Finally, none of these studies explored possible gender differences in time perception of emotional events even though it has been shown that men and women respond differently to emotional stimuli.

In this study we pre-specified the time range and asked subjects to control the presenting time of a picture of facial expression (happy, angry or neutral) and to match it with the specified time range. Unlike Angrilli et al.[3] and Droit-Volet and Wearden[4], the subject here was receiving emotional stimulus and hence was more likely to be in an emotional state when he made the time estimation. Importantly, we investigated whether the impact of emotional state on time perception has different patterns in men and women. Furthermore, we varied systematically the pre-specified time, covering both the short (500 ms to 2 sec.) and the longer ranges (2 to 6 sec.).

## 1 Method

### 1.1 Subjects

Forty undergraduate students from Peking University, twenty male and twenty female, volunteered to participate in the 30-minute experiment. They had normal or corrected-to-normal vision and had no histories of psychiatric or neurological disorders.

### 1.2 Stimuli and design

Three types of pictures were selected from a standard Chinese Facial Expression System[6]. Each picture had been assessed for its valence and intensity with a large sample of Chinese subjects. Each type had 24 pictures, with high arousal images for happy and angry expressions ($6.01 \pm 0.9$ on a 9-point scale in terms of intensity for happy expressions and $6.91 \pm 1.2$ for angry expressions). Half of the 24 pictures in each type were from men, half from women.

The pre-specified time ranges (0.5 sec, 1 sec, 1.5 sec, 2 sec, 4 sec, and 6 sec) were blocked, such that in one block subjects were to control the presenting time of different pictures over trials to match it with the pre-specified range. There were 36 testing blocks, with each time range having 6 blocks. Each block had 4 pictures randomly drawn from each of the three picture types. All the 24 pictures in each picture type were used once in each time range. The 36 testing blocks were grouped into 6 bigger blocks, with one smaller block for each of the time ranges. Within each bigger block, the order of presenting the smaller blocks was randomized over subjects.

### 1.3 Procedure

The subject sat in a comfortable chair in frontal of computer screen in a dimly lit room. His head was stabilized with a chinrest, with a distance of 70 cm between the subjects' eyes and the screen. For each block, the subject was instructed on the screen about the standard time range and was then asked to control and match the presenting time of each of the pictures in this block to this pre-specified time. For each trial, a central fixation sign ("+") was presented for 500 ms. Then a facial picture was presented and the subject click the mouse to stop the presentation. Each picture measured $8.1° \times 8.1°$ in visual angle.

## 2 Results

For each subject in each condition, response times that were 3 standard deviations away from the mean were removed. The accuracy of time estimation was then expressed as the difference between the time estimated and the time pre-specified, divided by the time pre-specified (%). The transformed data represent both the extent and direction of misestimation. Positive values indicate overestimation over the pre-specified time while negative values indicate underestimation[7].

An analysis of variance (ANOVA) was performed, with stimulus type (happy, angry and neutral) and time range (0.5 sec, 1 sec, 1.5 sec, 2 sec, 4 sec, and 6 sec) as two within-subject factors and gender group as a between-subject factor. The main effect of time range was significant, $F(5,190) = 19.54$, $p < 0.001$, indicating that the accuracy of time estimation varied over the pre-specified time ranges. While the short time ranges showed overestimation and the size of overestimation steadily decreased (39.1% for 0.5 sec., 20.6% for 1 sec., 4% for 1.5 sec., and 13.4% for 2 sec., 8% for 4 sec), the longer time ranges showed underestimation (2.5% for 6 sec.; see Fig. 1). The main effect of stimulus type was significant, $F(2,76) = 6.81$, $p < 0.01$, indicating that the accuracy of estimation varied over the three types of facial expressions, with the happy expression showing the largest overestimation (14.0%), the angry expression showing the smallest overestimation (9.6%), and the neutral expression in the middle (12.4%). The main effect of gender

group was significant, $F(1,38)=5.75$, $p<0.05$, with women showing more overestimation (23.3%) than men (0.6%; see Fig. 2).

The interaction between stimulus type and time range was marginally significant, $F(10,380)=1.65$, $p=0.06$. While the time perception was influenced by the three types of expressions at the short time ranges: 0.5 sec., 1 sec., and 2 sec.; $F(2,76)=3.38$, $p<0.05$; $F(2,76)=4.35$, $p<0.05$; and $F(2,76)=6.53$, $p<0.05$ respectively, the effect of facial expressions disappeared at the longer time ranges: 4 sec., and 6 sec.; $F(2,76)=0.8$, $p>0.1$; $F(2,76)=0.42$, $p>0.1$. At the short time ranges, the happy expression constantly showed overestimation compared with the angry expression (see Fig. 3).

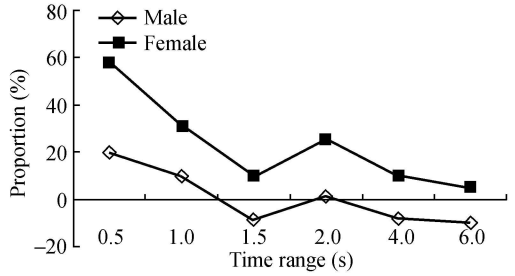


Fig. 1. Proportion of misestimation as functions of time range and gender.

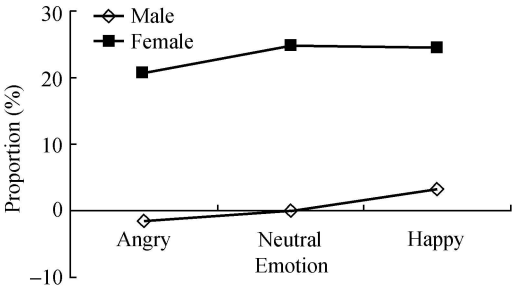


Fig. 2. Proportion of misestimation as functions of stimulus type and gender.

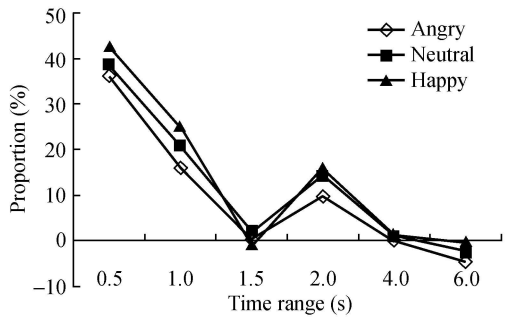


Fig. 3. Proportion of misestimation as functions of time range and stimulus type.

## 3 Discussion

By asking subject to control the presenting time of pictures of facial expressions and to match it with a pre-specified time range, this experiment obtained several important findings: (1) compared with the pre-specified time, subjects overestimated the presenting time for happy, angry and neutral expressions in general; however, compared with the neutral condition, subjects tended to underestimate the time for angry expressions and overestimate the time for happy expressions; (2) women overestimated the time range for all the three types of expressions; (3) the size of overestimation steady decreased over time ranges (0.5—6 sec), and the differences between expressions maintained only at the short time ranges (0.5—2 sec.).

Categorizing outside stimulus affectively and responding accordingly are rudimentary processes of biological organisms[8,9] and this categorization has specific activities in dorsolateral prefrontal cortex[10]. Stress or anxiety may accelerate a person's "internal clock" (more time passing on the clock than it may actually be), which results in a perception of time passing slowly[5]. Moreover, people typically want an unpleasant situation to end as soon as possible and the anticipation of this desired goal makes it seem that time is dragging. Schiff and Thayer[11] used this notion to explain the longer time estimates of subjects who made eye contact with people with negative facial expressions. Similarly, the spider-phobic subjects in the work of Watts and Sharrock[12] believed that the time dragged until the spider placed on a table in front of them was removed. Taken together, these studies suggest that time seems to pass slowly when a person is in a state of tension. Positive emotion serves as a cue to keep us staying in course and exploring the environment; negative emotion, on the other hand, serves as a call for calibration of psychological and physical systems and for behavioral adjustment. Thus, it is natural for people to stay in a positive state of emotion and to escape from the negative situation. Consequently subjective time tends to pass faster in positive mood and slower in negative mood than the real time, resulting in the feeling of "flying time" or "a day liking a year".

In this study, the subjects were asked to estimate time duration while emotional events were being presented. Thus in this situation the estimated time

duration relies crucially on attention-demanding processes that occur concurrently with the processing of non-temporal information[13]. Processing emotional information and estimating time duration use the same pool of attentional resources, with competition between the two types of processing. The subjects must divide attention between temporal and emotional information processing, and the accuracy of time perception is directly related to the amount of attentional resources allocated to time processing[5,14,15]. If a person focuses more attention on temporal information processing, more time signals are processed and longer time range is estimated. Conversely, the more resources are available to the processing of emotional events, the fewer signals accumulate in the cognitive time counter, the shorter the time is perceived, and hence the longer subjects control the presentation of pictures to reach subjective time range. As time goes by, the processing of facial expressions is near completion and more spared attentional resources are devoted to time perception, resulting in the steady decrease of the size of overestimation. The overall pattern of more overestimation in the happy expression than in the angry expressions can be explained in the same way by the distribution of attentional resources over processing of emotional and temporal information.

The novel finding of gender differences demonstrates that women are more likely to overestimate time duration than men when they are in the emotional state. We speculate that time perception in women are more likely to be context-dependent, susceptible to environmental cues, such as emotional information, while men mainly depend on their physiological clock system to estimate time. Women encode emotional events in greater detail than men[16] and are more likely to be attracted by emotional stimuli and social cues. They hence distribute fewer attentional resources to temporal perception, resulting in overestimation in the task.

In conclusion, this study suggests that time perception is influenced by the emotional state the perceiver is in, and women are more likely to overestimate time range than men.

## References


1 Wild B, Erb M and Bartels M. Are emotions contagious? Evoked emotions while viewing emotionally expressive faces：Quality, quantity, time course and gender differences. Psychiatry Research, 2001, 102：109—124

2 Wrase J, Klein S, Gruesser SM, et al. Gender differences in the processing of standardized emotional visual stimuli in humans：A functional magnetic resonance imaging study. Neuroscience Letters, 2003, 348：41—45

3 Angrilli A, Cherubini P, Pavese A, et al. The influence of affective factors on time perception. Perception & Psychophysics, 1997, 59：972—982

4 Droit-Volet S and Wearden J. Perception of the duration of emotional events. Cognition Emotion, 2004, 18(6)：849—858

5 Zakay D and Block RA. Prospective and retrospective duration judgments：An executive-control perspective. Acta Neurobiologiae Experimentalis, 2004, 64：319—328.

6 Wang Y and Luo YJ. Standardization and assessment of college students' facial expression of emotion. Chinese Journal of Clinical Psychology, 2005, 13：396—398

7 Brown SW. Time perception and attention：The effect of prospective versus retrospective paradigms and task demands on perceived duration. Perception & Psychophysics, 1985, 38：115—124

8 Cacioppo JT and Gardner WL. Emotion. Annual Review of Psychology, 1999, 50：191—214

9 LeDoux JE. Emotion. Annual Review of Psychology, 1995, 46：209—235

10 Grimm S, Schmidt CF, Bermpohl F, et al. Segregated neural representation of distinct emotion dimensions in the prefrontal cortex—An fMRI study. NeuroImage, 2006, 30：325—340

11 Schiff W and Thayer S. Cognitive and affective factors in temporal experience：Anticipated or experienced pleasant and unpleasant sensory events. Perceptual and Motor Skills, 1968, 26：799—808

12 Watts FN and Sharrock R. Fear and time estimation. Perceptual and Motor Skills, 1984, 59：597—599

13 Perbal S, Pouthas V and Vander LM. Time estimation and amnesia：A case study. Neurocase, 2000, 6：347—356

14 Burle B and Casini L. Dissociation between activation and attention effects in time estimation：Implication for internal clock models. Journal of Experimental Psychology：Human Perception and Performance, 2001, 27：195—205

15 Lejeune H. Switching or gating? The attentional challenge in cognitive models of psychological time. Behavioural Processes, 1998, 44：127—145

16 Seidlitz L and Diener E. Sex differences in the recall of affective experiences. Journal of Personality and Social Psychology, 1998, 74：262—271