

# Affective Priming with Subliminal Auditory Stimulus Exposure

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**Abstract.** The primacy hypothesis about affection (Zajonc, 1980) holds that positive and negative affective reactions can be elicited with minimal stimulus input and virtually no cognitive processing. This hypothesis challenges the cognitive appraisal viewpoint (Lazarus, 1982), which maintains that affection cannot emerge without prior cognitive mediation. There have been many studies shown that human emotion could be affected by subliminal visual stimulus, so how about subliminal auditory stimulus (SAS)? In this study two pieces of traditional Chinese music were used as SAS, and the unheard music was played in a continuous loop, which was different from the commonly used priming paradigm. 56 undergraduates were randomly divided into two groups; participants in one group were exposed to the subliminal happy music, and in the other group were exposed to the subliminal sad music. A before-and-after self-paired design was used to assess the emotion of all the subjects. During the experiment their galvanic skin response (GSR) and subjective ratings were recorded. The results showed that SAS caused the obviously change on human's GSR, but there was no change found in their subjective ratings of emotional valence (happy-unhappy). A lot of evidence showed that GSR was more sensitive than subjective ratings for the evaluation to current emotion status. The overall results of our study confirmed this perspective. So, we believed that SAS affected people's emotion, and this kind of affective priming wasn't perceived consciously by people themselves.

**Keywords:** Effective priming, Subliminal auditory stimulus, Emotion, Unconscious.

## 1 Introduction

The relationship between emotion and consciousness is becoming a research hotspot in psychology. Many scholars have done lots of experiments and found that emotional perception, especially negative emotion perception could occur without conscious awareness. In recent years, numerous relevant studies have been conducted using fMRI and ERP technology. The fMRI and ERP technology are non-invasive method of measuring brain activity during cognitive processing. Psychologists investigate brain activity related to affective changes. However, the results of their studies have often been inconsistent.

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Neuro-imaging studies have shown that emotional stimuli, especially fearful facial expression, elicit strong activation of the amygdala even when the expressions are spatially unattended or backward masked and inaccessible to conscious awareness [1]. This functional imaging work is particularly interesting in that the enhanced activation of the amygdala has been activated in response to unconscious threat-related stimuli. This result is consistent with the view that in a binocular rivalry paradigm, even during suppressed periods of binocular rivalry, fearful faces still generate a strong response in the amygdala. Compared with the visible condition, binocular rivalry suppression also eliminated activity to fearful faces whereas amygdala activity was robust in both the visible and invisible conditions [2]. However, there are some studies which do not support the view that perceptual processing of emotional (especially threat) stimuli do not necessarily depend on conscious. On the basis of the fMRI study of Vuilleumier et al, Holmes explores the same problem using event-related brain potential (ERP) technology. In this event-related brain potential (ERP) study, Observers viewed emotional face stimuli, either attentively or inattentively. The experiments showed that visible emotional faces elicited a significantly larger negative deflection starting at 170ms (compared to invisible faces). Therefore, the author believes that emotional processing is dominated by consciousness [3]. Phillips and his colleagues investigated the relation of facial expression perception and conscious with functional magnetic resonance imaging (fMRI). A backward masking paradigm was used. In the psychophysics experiment, the following parameters were established: 30ms target duration for the non-consciously perceived (covert) condition, and 170ms target duration for the consciously perceived (overt) condition. Results of the block-design fMRI study indicated substantial differences underlying the perception of fearful facial expressions: the overt condition (170 ms) generated amygdala activation to fearful faces while in the covert condition (30 ms), the amygdala was not activated to fear [4]. Overall, the above inconsistent conclusions demonstrate that there is debate in cognitive neuroscience whether emotional stimuli can actually be perceived without awareness. Different laboratories have reached different conclusion, the reason is that levels of consciousness are manipulated by different method and stimuli are measured by different standards, whether the subjective threshold method or objective signal detection method.

Existing studies mainly focus on the emotional visual stimuli processing and it is unknown if subliminal stimuli of other sensory channels, such as auditory channel and tactile channel, can evoke emotional reactions. And it is not clear that whether the emotion processing activated by subliminal stimuli from different sensory channels is the same and how they are influenced by consciousness. Thus we study the effect of subliminal auditory stimuli on emotion, using electrophysiological measurement method to explore participants' emotion change activated by two pieces of traditional Chinese music. Music is an abstract symbolic language with no specific references or associations. Nevertheless, its intrinsic pattern and structure convey meaning to our brain [5]. This study will expand the research on emotional perception and consciousness. We predict that affective priming will be activated by subliminal auditory stimuli.

## 2 Method

### 2.1 Participants

28 participants (half men and half women, aged 21-27, mean age 23.64 years) recruited for this experiment are college students and all of them have normal visual acuity (or corrected visual acuity). All participants reported normal hearing and no history of neurological disease. Participants were non-musicians who had no formal musical training (besides typical school education) and had never learned to play a musical instrument. Participants were asked to sign an informed consent form before commencing testing, and were paid for their participation. The whole test session lasted about 16min.

### 2.2 Apparatus

The experiment stimuli were presented by Lenovo computer (Intel Pentium 4). Participants heard the auditory stimuli through headphones. All physiological recordings were performed by a Biopac MP150 system (Biopac Systems Inc., USA).

### 2.3 Experimental Materials

- **Subliminal Auditory Stimuli.**

The Subliminal sound files were edited by Adobe Audition Software.

*a) The happy song.*

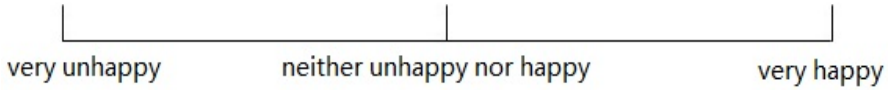
The Chinese Folk Symphony 《Spring Festival Overture》 was selected as the subliminal happy music. The happy music was masked by a loud sound of mental arithmetic task, and the target sound intensity level was 42 dB higher than the level of masking sound. The song lasted eight minutes. The music continued playing during the whole experiment period. Participants completed mental addition of 1-digit number and 1-digit number in the first two minutes and mental subtraction of 1-digit number and 1-digit number in the last two minutes. In the middle four minutes, participants rested and kept listening to the subliminal music, the sound intensity level of which was 0db.

*b) The sad song.*

The Chinese famous music 《Moonlight on The Pond》 was selected as the subliminal sad music. The sad music was masked by a loud sound of mental arithmetic task, and the target sound intensity level was 37 dB higher than the level of masking sound. The song lasted eight minutes. The music continued playing during the whole experiment period. Participants completed mental addition of 1-digit number and 1-digit number in the first two minutes and mental subtraction of 1-digit number and 1-digit number in the last two minutes. In the middle four minutes, participants rested and kept listening to the subliminal music, the sound intensity level of which was 0db.

- **The Emotion Self-Rating Scale.**

As shown in Figure 1, the whole length of the emotion self-rating scale is 13cm. The point of "very unhappy" has a coordinate of -6.5, and the coordinate of 0 for "neither unhappy nor happy" and the coordinate of 6.5 for "very happy".



**Fig. 1.** The emotion self-rating scale

## 2.4 Procedure and Experimental Design

The experiment was conducted in a sound-proof and electrically shielded cabin. On arrival at the laboratory, participants were told that the study consisted of a mental arithmetic task. Participants were seated in a comfortable self-adjustable chair. The subliminal auditory stimulus (music) was presented through headphones during the whole experiment. Every participant was asked to finish the task for two times, one time without subliminal stimuli and the other time with subliminal auditory music. The experiment lasted about sixteen minutes. Participants did not report experiencing any feelings in response to the primes.

A paired design and a paired analysis were employed in this study. The presentation order is completely balanced. The independent variable was emotional priming, including two levels: no stimuli and subliminal auditory stimuli. The dependent variables used to value emotion in this research were galvanic skin response (GSR) and emotion self-rating results.

## 3 Results

The key question addressed by our analyses was whether subliminal auditory primes influence participants' emotion.

### 3.1 The Galvanic Skin Response (GSR)

#### a) Listening to the Happy Music of 《Spring Festival Overture》.

The statistical results of participants' GSR are provided in Table 1.

**Table 1.** The descriptive statistics of GSR (N=28, hearing happy music)

	GSR	
	M ( $\mu$ mho)	S ( $\mu$ mho)
No Subliminal Stimuli	0.091	0.022
Subliminal Happy Music	0.075	0.018

Paired-Samples T Test was used to explore the impact of sub threshold happy music on GSR. The results showed that there were significant differences,  $t(27) = 2.226$ ,  $p = 0.030^*$ . Obviously, the subliminal music of 《Spring Festival Overture》 significantly affect the participants' GSR.

**b) Listening to the Sad Music of 《Moonlight on The Pond》 .**

The statistical results of participants' GSR are provided in Table 2.

**Table 2.** The descriptive statistics of GSR (N=25, hearing sad music)

	GSR	
	M ( $\mu$ mho)	S ( $\mu$ mho)
No Subliminal Stimuli	0.091	0.022
Subliminal Sad Music	0.077	0.029

Paired-Samples T Test was used to explore the impact of sub threshold sad music on GSR. The results showed that there were significant differences,  $t(24) = 2.269$ ,  $p = 0.037^*$ . Obviously, the subliminal music of 《Moonlight on The Pond》 significantly affect the participants' GSR.

### 3.2 The Emotion Self-rating Results

**a) Listening to the Happy Music of 《Spring Festival Overture》 .**

The statistical results of emotion self-rating are provided in Table 3.

**Table 3.** The descriptive statistics of emotion self-rating (N=28, hearing happy music)

	Emotion Self-Rating	
	M	S
No Subliminal Stimuli	2.226	1.850
Subliminal Happy Music	2.690	1.928

Paired-Samples T Test was used to explore the impact of sub threshold happy music on emotion self-rating. The results showed that there was no difference,  $t(27) = 1.693$ ,  $p = 0.118$ .

**b) Listening to the Sad Music of 《Moonlight on The Pond》 .**

The statistical results of emotion self-rating are provided in Table 4.

**Table 4.** The descriptive statistics of emotion self-rating (N=25, hearing sad music)

	Emotion Self-Rating	
	M	S
No Subliminal Stimuli	1.307	1.384
Subliminal Sad Music	0.842	2.101

Paired-Samples T Test was used to explore the impact of sub threshold sad music on emotion self-rating. The results showed that there was no difference,  $t(24) = 1.5045$ ,  $p = 0.176$ .

## 4 Discussion and Conclusions

Subliminal perception is a kind of unconscious perception, people can not consciously perceive. Plenty of studies have found that the level of unconscious processing is relatively low. That is to say, with the influence of unconscious perception, one can process the physical characteristics of the word, without understanding the meaning [6-8]. The research on affective priming has a long history of more than 30 years. The affective primacy hypothesis holds that affective reactions can be elicited with minimal stimulus input [9]. This hypothesis challenges the cognitive appraisal viewpoint, which maintains that affect cannot emerge without prior cognitive mediation [10]. Indeed, the affective primacy hypothesis hinges on the assumption that the simple affective qualities of stimuli, such as good versus bad or positive versus negative, can be processed more readily than their non-affective attributes. The mere exposure paradigm, however, provides only indirect evidence for this contention. Clearly, more direct evidence is needed.

In our experiment, we explored the effect of subliminal auditory music on emotion, and the presentation of subliminal stimuli was different from traditional unconscious stimuli forms. We made the auditory stimuli unheard by an ideal sound-masking solution. In addition, the subliminal stimuli in our experiment persist during the whole experiment time. Comprehensively analyzing the experiment results, we found that subliminal emotional music greatly influenced human's galvanic skin response (GSR), but did not have significant effect on their own feelings. The galvanic skin response seemed to be a reliable measure of emotional intensity when emotion was viewed not as a special type of mental or behavioral state but rather as a description of an individual who was energized, activated, mobilized for emergency. GSRs had been found to be relatively great to words which were emotionally toned, meaningful, conflicting, and tension or fear-arousing[11]. Rankin and Campbell found highly significant differential GSRs ( $P < .001$ ) in subjects to Negro and white experimenters [12]. Based on the psycho physiological significance of GSR, it was suggested that although all the participants did not hear the emotional music, but they were indeed significantly affected by those subliminal sound. It was apparent that affect could be elicited without the participation of subjects' awareness. More interesting, however, was the fact that the non-conscious priming of affective reactions under certain conditions might be more successful than when it was with subjects' full awareness. What were the differences between conscious and non-conscious priming? The results showed that participants did not feel their mood change but their physiological indexes (GSR) changed obviously. It seemed quite possible that the techniques which may be effectively used to activated emotion. Because emotion elicited by this way would be more natural and more sustainable. Furthermore, this kind of emotion may be more able to influence people's behavior.

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