



## Research article

# Moderate anxiety modifies the electromyographic activity of a forearm muscle during a time-reaction task in women



C. Langlet, J.P. Hainaut, B. Bolmont\*

Université de Lorraine, LCOMS/2LPN-CEMA Group (Cognition-EMotion-Action), EA 7306, Metz F-57070, France

## HIGHLIGHTS

- Anxiety increases premotor time's EMG activity in a complex ecologic movement.
- Arousal anxiety has a different impact on voluntary motor processes.
- Shortening reaction time in anxiogenic condition was due to higher muscular activity.

## ARTICLE INFO

## Article history:

Received 14 November 2016  
 Received in revised form 7 February 2017  
 Accepted 8 February 2017  
 Available online 10 February 2017

## Keywords:

Anxiety  
 Muscular activity  
 Premotor  
 Motor time  
 Reaction time  
 Women

## ABSTRACT

Arousal anxiety has a great impact on reaction time, physiological parameters and motor performance. Numerous studies have focused on the influence of anxiety on muscular activity during simple non ecologic task. We investigate the impact of a moderate state-anxiety (arousal stressor) on the specific component of a complex multi-joint ecologic movement during a reaction time task of auditory stimulus-response. Our objective is to know if central and peripheral voluntary motor processes were modulated in the same way by an arousal stressor. Eighteen women volunteers performed simple reaction time tasks of auditory stimulus-response. Video-recorded Stroop test with interferences was used to induced moderate state-anxiety. Electromyographic activity of the wrist extensor was recorded in order to analyse the two components of the reaction time: the premotor and motor time. In anxiogenic condition, an acceleration and an increase of muscular activity of the reaction time was obtained. This increase was due to a stronger muscle activity during the premotor time in the anxiogenic condition. Arousal anxiety has a different impact on central and peripheral voluntary motor processes. The modifications observed could be related to an increase in arousal related to a higher anxiety in order to prepare the body to act.

© 2017 Elsevier B.V. All rights reserved.

## 1. Introduction

State-anxiety is defined as a transitory emotional state characterized by subjective perceived feelings of tension and apprehension occurring in stressful situations. Exposure to stressor is associated with increased state anxiety and physiological modifications, such as activation of the sympathetic nervous system (e.g., increased heart rate, blood pressure, sweat gland activity, respiration rate, etc.), neuroendocrine system (enhancement of catecholamine and cortisol secretion) [1,2], and modification of

muscular tension [3–5]. Evidence suggests that motor performance can be influenced positively by state anxiety in simple tasks, such as stimulus-response, [6,7]. These authors have shown that in healthy subjects, a moderate anxiety state could enhance reaction and movement time in an auditory response time tasks. They have suggested that anxiogenic condition has increased arousal which could improve attention and lead subjects to process stimuli more actively. In addition, in line with the concept of “Fight or Flight” [8], state-anxiety could have increased muscular tension, enhancing the motor performance and prepare the body to act.

An important number of works has focused on the link between anxiety and muscular tension in healthy and pathological subjects [5,9–12]. This impact of anxiety on muscular activity has been widely studied using surface electromyography (EMG) in different motor tasks and with different kind of stressors. Some studies have focused on the effect of a stressful cognitive task such as the stroop color-word interference test, on tonic muscular activity and reported a global increase in different muscles of the

*Abbreviations:* CST, Corticospinal tract; DT, Displacement time; EMG, Surface electromyography; IAPS, International Affective Picture System; MT, Motor time; MU, Motor unit; PMT, Premotor time; RT, Reaction time.

\* Corresponding author at: UFR Sciences Fondamentales Appliquées, Département STAPS, Campus Bridoux, Rue du Général Delestraint, 57070 Metz, France.

E-mail address: [benoit.bolmont@univ-lorraine.fr](mailto:benoit.bolmont@univ-lorraine.fr) (B. Bolmont).

<http://dx.doi.org/10.1016/j.neulet.2017.02.024>

0304-3940/© 2017 Elsevier B.V. All rights reserved.

body (trapezius, gastrocnemius, frontalis muscle) during the task [4,13,14]. Others studies have assessed the effect of a stressor, during a voluntary movement, on muscular force [15,16], submaximal fatiguing contraction [17], precision tasks [18] or music performance [19] and consistently reported increased EMG activity in the upper extremity muscles. In these works, the effect of anxiety is observed on the whole movement and this kind of analysis couldn't give informations about the central or peripheral motor processes impacted by a stressor. Some works [20,21] have focused on how emotion altered the different components of the motor system in a simple repetitive task, such as simple reaction time (RT). RT task consists of a presentation of one single 'go-signal' and one response and is known to be influenced by anxiety [6,7]. Recording EMG activity on the responding muscle has allowed a fractionation of the RT into two components providing information on the motor control: the premotor time (PMT), which is the interval between the onset of a stimulus and the onset of the relevant EMG activity; and the motor time (MT) which is the duration of the EMG activity until the onset of the movement [22]. It is generally suggested that PMT indicates the information-processing time needed by the central nervous system, whereas the MT is related to the execution of the motor action [23–26]. Using International Affective Picture System (IAPS, [27]), Hälbig et al. and Coombes et al. [20,21] have evaluated the effects of emotional arousal and valence on PMT and MT during a RT task. In the first study, the subjects have to press a button rapidly to the left or right side if the picture is a new or old one. Authors have shown that exposure to unpleasant stimuli and high arousal increased temporal parameters of PMT and MT compared to neutral ones. In the study of Coombes et al. [21], participants executed a bilateral extension of the wrist and finger muscles against two load cells while being exposed to IAPS pictures (with positive and negative valence) during a stress of apprehension. Startle and tone acoustic cues were used as signal in order to execute quickly the movement which has been planned at the onset of the picture. The valence has no significant effect on PMT and MT but a greater force onset latency was obtained. In this study, the movement could not be considered as an ecologic movement (simple movement of wrist extension) and no psychological evaluation of emotion has been obtained. Moreover, in these studies, the EMG activity was only used to determine the PMT and MT parameters but no information on the effect of emotions on muscle activity during movement is given.

Based on the contrasting results of the two previous studies, the aim of our work was therefore to investigate the impact of a moderate state-anxiety (arousal stressor) on the specific component of a complex multi-joint ecologic movement during a reaction time task of auditory stimulus-response. We have recorded the EMG of an upper limb prime-mover muscle (extensor of the wrist) involved in the first part of the movement. Our objective was twofold: 1/study the impact of an arousal anxiety on the information processing and motor processes in order to determine whether the anxiety affects the peripheral or central process; 2/determine if an increase in muscular activity could explain the shortening reaction time in anxiogenic condition. We can hypothesize that the arousal anxiety enhanced the subject attention and the muscular activity and then improved the PMT and MT components. Furthermore, the modifications of the EMG activity observed could be related to change in the excitability of the motor command.

Gender differences have been shown in response to emotional stress. Women are more likely than men to be diagnosed with depression and anxiety – related disorders and these differences seems to be related to sex difference in stress reactivity [28]. Furthermore, women tend to experience negative emotions at a greater frequency and intensity than men [29], have greater sympathetic response to acute stressors (for review see [30]), and have greater neuromuscular modifications after a cognitive stress [17].

In order to heighten the main effect of anxiety throughout the experience, our protocol has been performed exclusively in women.

## 2. Material and methods

### 2.1. Subjects

Twenty-one right-handed women volunteers ( $24.3 \pm 7.48$  years old), recruited from the graduate and undergraduate population, participated in the study. They all gave their informed consent and declared to be free of psychiatric, neurological or cardiovascular diseases, to possess normal hearing and vision and not to take any medication. Women were excluded if they reported irregular menstrual cycle or premenstrual complaints. We have rejected 3 over 21 subjects because they have more than 5% of anticipation. So, the statistical analysis was obtained on 18 subjects. Our noninvasive research has been carried out in accordance with The Code of Ethics of The World Medical Association (Declaration of Helsinki).

### 2.2. Psychological and physiological measurement

State anxiety was assessed in the control condition and at the end of the experiment (anxiogenic condition) with the Y1 form of the Spielberger State-Trait Anxiety Inventory (STAI, [31]). This self-evaluated questionnaire consists of 20 items, each scored in a four-point scale.

### 2.3. Response time tasks

The subjects' performances in response time were assessed using a simple task given one auditory modality. The auditory stimulus was a pure tone of 1000 Hz presented binaurally. Each tasks consisted of 30 signals that occurred in a random delay within 1.4 and 2 s after positioning the hand on the home button of the serial response box. Subjects had to stay on the home button placed at the middle until the stimulus occurrence. Then, they have to press as quickly and accurately as possible the response button located at 7 cm to the right of the home button.

Response times were distinguished in two components: (i) RT, i.e. the time required to evaluate the stimulus, to select and trigger the response, and (ii) displacement time (DT), i.e. the time required to execute the motor response. Accordingly, RT was measured as the time spent from the stimulus occurrence to the subject's movement onset (i.e. when the subject released the home button); displacement time was evaluated as the time spent from the release of the home button to the subject's subsequent press of the response button [32]. The RT was divided into two components: PMT, which is the interval between the onset of a stimulus and the onset of the relevant EMG activity; and MT, which is the duration of the EMG activity until the onset of an actual movement (see Fig. 1). All tests were programmed with E-prime (Psychology Software Tools, Inc.). Performance in each response time tasks was assessed in thousandths of a second by calculating the mean value for 30 responses.

### 2.4. Control and anxiogenic condition

Two Stroop test versions [33] were used to induce control and anxiogenic conditions. In the first condition (control condition), subjects were asked to perform the Stroop test without interference (ST) that was made of congruent colors. The subject was seated in front of a board with 100 of the color-naming word blue, yellow, red, green and violet printed in congruent colors and presented in a randomised order. The subject had to name the color without time limit. The subject was not video recorded.

Download English Version:

<https://daneshyari.com/en/article/5738470>

Download Persian Version:

<https://daneshyari.com/article/5738470>

[Daneshyari.com](https://daneshyari.com)