MENTAL STRESS INFLUENCE ON MOVEMENT

CLAUDIO BORNIQUEZ, MARCELLO CRIVELLINI, LUIGI DIVIETI, MANUELA GALLI(*)

BIOENGINEERING DEPT., (*) D.S.T.M DEPT., POLITECNICO DI MILANO, MILANO, ITALY

INTRODUCTION

Previous researches tried to inquire into the mental activities can bias body activities.

These studies show that a mental stress situation produces a transitory increment of body internal temperature and a variation of emodynamical parameters as hart rate and arterial pressure both in healthy and in cardiophatic subjects (Mazzueno 1983, Ravizza 1989).

In this paper we analyzed how a mental stress condition can change the normal execution of a particular movement is analyzed. The movement tested in this work is the right leg extension movement of 15 subjects in normal conditions and under different load situations and under mental stress conditions produced by the computation of a particular progression.

METHODS

For this analysis the right leg extension movement of 12 men and 3 women, whose general characteristics are reassumed in table I, was analyzed.

	Age (years)	Profession	Height (m)	Weight (Kg)
Men	28f1.2	University students	1.79M.8	73M.7
Women	24±0.7	University students	1.68±0.6	58±0.8

Table I: General characteristics of female and male subjects

The movement analysis was carried out using the ELITE system. This, system uses optoelectronic sensor (special non metric TV cameras) and passive lightweight markers wluch reflect the infrared light coming from a circular ring of LEDs coaxial with the lenses of the TV cameras. The system is hierarchically organised on two level: the first provides for marker recognition and is implemented by a dedicated hardware processor, the second is devoted to the software processing of the spatial co-ordinates of the markers. In particular the maximum height reached by the ankle was computed.

With the ELITE system the coordinates of 3 markers, stuck on the skin over hip, knee and ankle joint centres, were acquired (Fig. 1).

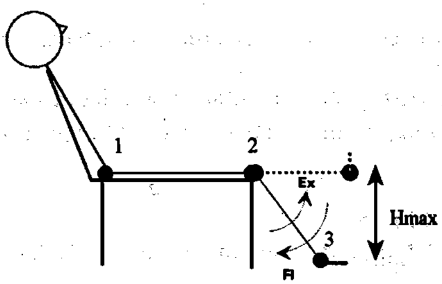

Fig. 1 Marker position and analyzed movement

Surface electromyographic (EMG) signals were recorded from rectus femoris **(RF), vastus medialis (VM)** and tibialis anterior **(TA)** and analyzed qualitatively. The signals were converted to light pulses, transmitted via fibreoptic cable and reconverted to an analogue signal, at which time they were **bandpass** filtered (10 - **2000** Hz).

A body-building seat, which consist in a bench with adjustable back and with a rotating "bracing" support for the weight installation, was used to make the right leg extension movement.

After the marker placement, the subjects were instructed to sit on the bench leaning against its back. The latter was inclined to avoid the influence of abdominal muscles on movement control.

The left leg during the movement was supported by the bench without contact with the ground, while the right foot was placed behind the rotating support. Then the subjects were asked to make the extension-flexion movement with closed eyes from a defined starter, lifting the support with the eventual loads.

The start and final positions were imposed by the bench while the complete extension position (H_{max}) was different in conformity with the situation.

The extension-flexion movement was made in these different situations:
- without weight in normal mental conditions;
- with increasing loads in normal mental conditions
- without and with increasing loads under stress mental conditions.

The mental stress condition was induced in the **testman** using particular "Stressor", **i.e** arithmetical computations. The results of these computations were said aloud. This **Stressor** are able to produce the change of physiological parameters as temperature, hart rate and blood pressure.

It is possible to define the **Stressor** as an arithmetical function S **[1**.1]

$$S = S(\pm n; m; E). \qquad [1.1]$$

The **Stressor** S depends, in first approximation, on the arithmetical'operation made **(+n**: addition -n: subtraction) and on the starter operation number (m).

The movement started when the subject reached, during the arithmetical progression, the prefixed number E.

Particularly for this work the Stressors, showed in table **II**, were used.

Stressor	Sequence
S1 = S(-3;101;71)	**101, 98,** 95, ..., **74, 71** GO!
S2 = **S(-7;251;195)**	251, 244, 237,....., 202,195 GO!
S3=S(-17;1013; 945)	1013,996, 979,....., 962, 945 GO!

Table **II** Aritmethical Stressors used to induce the mental stress situation

The total number of movement repetitions for each subject was limited to 16 to avoid the arising muscular fatigue.

The trial was not recorded if the computation was interrupted by the subject during the movement or if the interval time between two subsequent counts was too long (At **>5 sec).**

RESULTS AND DISCUSSION

The maximal height (H_{max}) reached by the ankle in the extended position was computed.

Analyzing the trial made without Stressor, with increasing loads, it was observed that the pattern of H_{max} versus used weight presents a relative maximum, as shown in Fig.2.

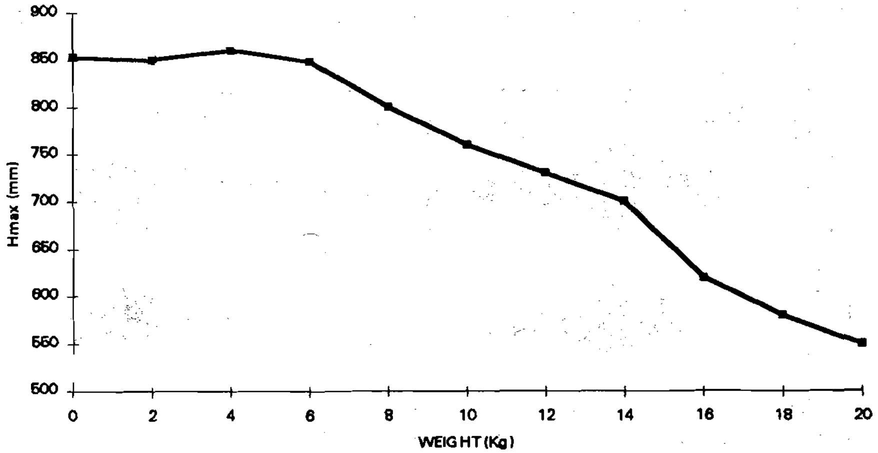

Fig.2 Trial without Stressor: H_{max} vs weight

The pattern shows that when the trial is made using a light weight (2-6 Kg). the height reached by the ankle is bigger then without weight. When the weight increases (over 6 Kg) the H_{max} continuously decreases.

The Fig. 3 shows the results of trial made using both increasing loads both **Stressor** S(-17).

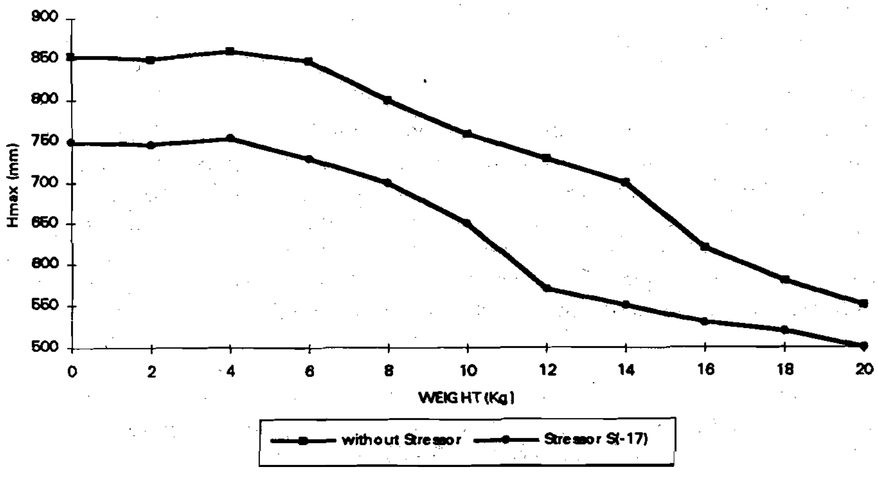

Fig.3 Trial with **Stressor S(-17):** H_{max} vs weight

In this paper is shown only the result about the use of **Stressor** S(- 17) because it is the arithmetical progression more significant.

From this pattern it is possible to observe that the **Stressor** presence limits the normal execution of movement: **the Hmax** reached by the ankle is lower in mental stress then in **normal** mental **situations**. Besides the influence of **Stressor** upon movement increases with the use of heavy weights.

Analyzing the EMG signals (Fig.4) it is possible to observe that the amplitude of VM and RF EMG signals decreases when the movement is made under mental stress conditions.

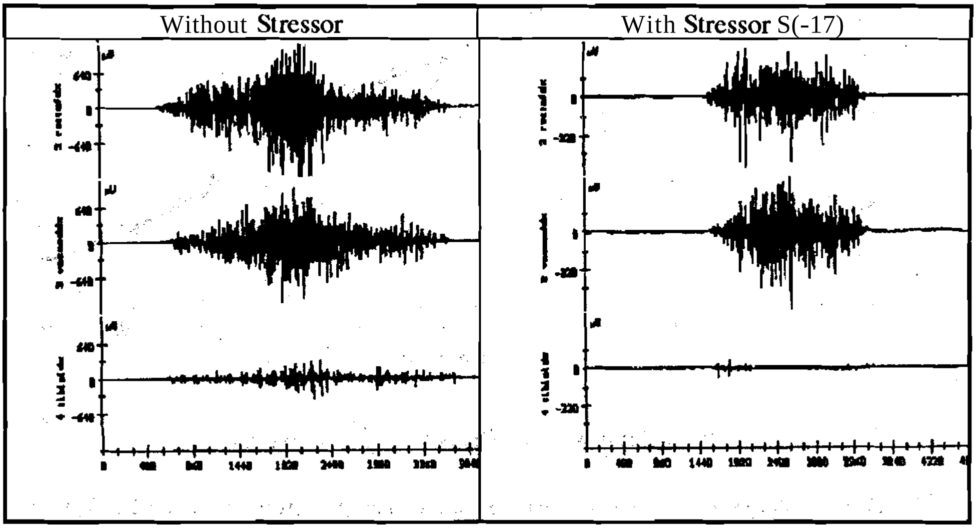

Fig.4 EMG signals with and without Stressor in the same loading situation.

The activity of TA muscle decreases considerably with the Stressor: in fact this muscle works only at the beginning of leg extension. These changes suggest to us to make a quantitative study of EMG signals that now we are developing for a better evaluation of the phenomenum.

CONCLUSIONS

The results of this study indicate that the mental activity influences the normal execution of the movement. In fact during the extension-flexion movement the hight reached by the ankle decreases if the subject is making numerical countdown. Besides the muscle activity change considerably. An open question is how the different level of concentration affects the movem'ent. Obviously we intend the concentration on movement that the subject will make. To evaluate this we are making some trial with the subject relaxed and with the subject concentrated on the movement that he is going to do.

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