# CORRELATION BETWEEN REACTION TIME AND AMPLITUDE CHANGES IN H-REFLEX, EVOKED BY MUSCLES AGONISTS OF A FORTHCOMING VOLUNTARY MOVEMENT IN FIXED FOREPERIOD EQUAL TO 1000 MSEC

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During fixed foreperiod equal to 1000 msec, changes in the H-reflex amplitude, evoked by the muscles agonists of a forthcoming voluntary movement, are established (Gerilovsky, Tzekov, 1969, 1971). In the second half of the period a decrease in the amplitude of H-reflex is noted, starting 400 msec, and most strongly manifested 800 msec after presentation the warning signal. Similar data were also reported by Requin (1969) in the course of investigations on amplitude changes in the T-reflex in similar experimental situations.

Personal preliminary studies, performed with six subjects. have shown that the correlation between reaction time and amplitude changes in the H-reflex, evoked during fixed foreperiod equal to 1000 msec, is rather complicated (Tzekov, Gerilovsky, 1970). It was moreover etsablished (Tzekov, Gerilovsky, Zlatarov, 1970) that in case of a less probable signal requiring a motor response, the decrease in H-reflex amplitude in the second half of the foreperiod is more weakly manifested, and the reaction time is longer.

The complex correlations outlined above led us to carry out the experiments described in the present work, aiming a more detailed clarification of the correlation between reaction time and changes in the monosynaptic reflexive excitation, tested at the spinal segment apparatus level through H-reflex.

## Methods

The studies were conducted in a series of 14 healthy male subjects aged 20 to 25 years. Each subject participated in one experimental series, consisting of 6—8 one-day long identical programs. During each one-day signal program, the subjects were presented pairs of identical light signals from a flash lamp through red filter. The first signal of the pair, according to beforehand instruction, was the warning one, while the second signal required a motor response (imperative signal). The motor response consisted of lifting the heel of one leg with maximum velocity from a button located on the floor. The interval between the warning and imperative signal was fixed and equal to 1000 msec. The interval between the single light pairs ranged from 16 to 20 seconds.

The reaction time was measured for each light pair using an electronic counter which was started synchronously with the signal requiring the motor response, and was stopped with lifting the heel from the button.

The H-reflex was evoked through stimulation of n. tibialis posterior in the fossa poplitea of the leg taking part in the motor response. The fixed foreperiod, equal to 1000 msec, was divided up into ten equal intervals of 100 msec each. The stimulating electrical impulse was single for each light pair. It was selected in a manner to fall independently, with equal probability and accidentally on one of the 11 points, i. e. simultaneously with the warning or with the imperative signal, or else at 100, 200, 300 etc milliseconds after the warning signal. The H-reflex was evoked from the m. gastrocnemius lateralis of the leg taking part in the motor response.

The one-day signal program consisted of 121 pairs of identical light signals, divided into three blocks. Prior to beginning, and at the end of each block, four control measurements of the H-reflex were performed in a resting state of the subjects, free of any presentation of light signals. The mean of the amplitudes of the H-reflexes for the eight measurements was accepted as the control H-reflex at rest for the respective block. The amplitude of the single time evoked H-reflex for each light pair was compared with the amplitude of the control H-reflex for the respective block, and the respective increase or decrease was accounted for.

Using the method of linear correlation analysis, the correlation between reaction time for each light pair and amplitude changes in the corresponding H-reflex was recorded.

## Results and discussion

Table 1 illustrates the coefficients of correlation between reaction time and amplitude changes in the H-reflex. The results are submitted separately for each individual according to time of evoking the H-reflex after the warning signal.

The data show that in eight of the total number of 14 persons under study (NP, DCh, DK, II, PN, AV, HP and NV) a moderate or marked, direct or rarely inverse correlative dependence is established. The latter is manifested in a single or more intervals, and shows individual differences, both in terms of time, and in terms of significance in the individual subjects.

Changes in the H-reflex amplitude in time, summed up for the 14 subjects, run the course described by Gerilovsky and Tzekov (1969, 1971) (Fig. 1). The individual curves of the amplitude changes in H-reflex in 9 of the total number of subjects exhibit analogical changes. It should be stressed however, that in four of them (SS, GA, MH and VV) a slight correlative dependence is established between the reaction time and amplitude changes in H-reflex. On the other hand, in the subjects NP, AV and HP the H-reflex amplitude shows no decrease in the second half of the fixed foreperiod, and an evident correlation is observed.

The results of the present study corroborate our earlier conclusion according to which the correlation between reaction time and amplitude changes in the H-reflex under conditions of fixed foreperiod, equal to 1000 msec, is quite complex (Tzekov, Gerilovsky, 1970). In the simple motor task setup without warning signal, the character of this correlation has the form of curve with a minimum (Tzekov, Gerilovsky, 1974). As pointed out by Semjen et al (1972), the mechanisms causing depression of the H-reflex amplitude in the second half of the foreperiod (equal to 700 msec) are by no means linked to

**Correlative dependence between reaction time**
(Coefficients

| Interval in msec after the warning signal | S. S. | G. Al. | N. P. | D. Ch. | G. A. |
|---|---|---|---|---|---|
| 0 | 0,03 | 0.13 | —0.21 | 0.10 | —0.09 |
| 100 | —0.25 | 0.17 | 0.13 | —0.08 | 0.05 |
| 200 | 0.11 | —0.17 | 0.30 | 0.00 | —0.22 |
| 300 | 0.00 | —0.04 | 0.09 | —0.05 | —0.20 |
| 400 | —0.02 | —0.11 | 0.59 | —0.02 | 0.01 |
| 500 | —0.15 | —0.27 | 0.35 | —0.03 | —0.20 |
| 600 | 0.17 | —0.20 | 0.03 | 0.13 | 0.19 |
| 700 | 0.00 | 0.12 | 0.19 | 0.06 | 0.17 |
| 800 | —0.09 | —0.14 | —0.11 | 0.25 | 0.05 |
| 900 | —0.05 | —0.12 | 0.08 | 0.13 | —0.10 |
| 1000 | 0.03 | —0.24 | —0.23 | 0.41 | —0.21 |

the preparation for a quicker response, since they are designed to inhibit or eliminate any undue external influence. In the opinion of Paltzev and Elner (1967), the preparation for a voluntary movement and the basic movement itself run a course as two joint, but by no means conditioning each other pro-

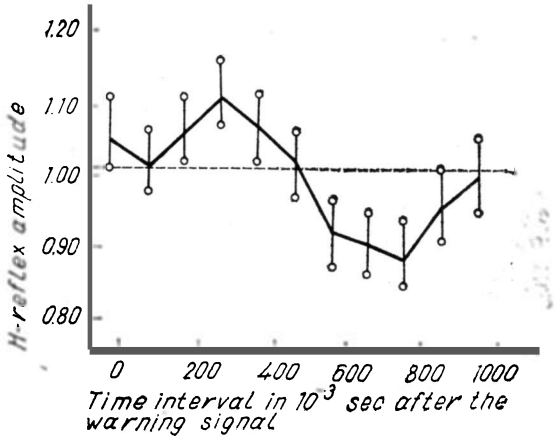


Fig. 1: Mean values of amplitude changes in H-reflex during fixed foreperiod, equal to 1000 msec, in 14 subjects. The H-reflex is evoked from m. gastrocnemius lateralis which is the agonist of a forthcoming voluntary movement — plantar flexion of the foot. The amplitude H-reflex changes (on the ordinate) are expressed as function of the time after the warning signal during which the reflex was evoked (on the absciss). The confidence limit, expressed with a vertical line at each point, is estimated at $p=0.05$. The dotted line indicates the values of the amplitude of the control H-reflex.

cesses. In earlier investigations (Tzekov, Gerilovsky, Zlatarov, 1970) we were successful in demonstrating that in case of a lesser likelihood of the imperative signal, the decrease in the H-reflex amplitude is smaller, and the reaction time — longer. Moreover, it is obvious that moderate or significant coefficients of correlation between reaction time and amplitude changes in the H-reflex, when it is evoked 400 or more milliseconds after the warning signal, are prevalently with a positive sign. Also, this suggests that if the decrease of the H-reflex amplitude in our experimental situation is taken to be an expression of beforehand preparation for the forthcoming voluntary movement, these changes would be linked up to a certain degree also to the task assigned

Table 1

**and amplitude changes in H-reflex**
of correlation)

| D. K. | I. I. | V. K. | M. H. | P. N. | A. V. | H. P. | N. V. | V. V. |
|---|---|---|---|---|---|---|---|---|
| —0.02 | —0.32 | 0.22 | —0.20 | 0.32 | 0.45 | —0.52 | —0.39 | 0.05 |
| —0.12 | 0.00 | —0.01 | —0.13 | —0.55 | —0.07 | —0.41 | —0.16 | —0.21 |
| 0.02 | —0.19 | 0.13 | —0.02 | —0.27 | —0.11 | —0.15 | —0.04 | —0.06 |
| —0.06 | —0.14 | —0.03 | —0.13 | 0.35 | —0.01 | —0.17 | —0.11 | —0.17 |
| 0.15 | —0.28 | 0.17 | 0.21 | 0.43 | 0.01 | 0.00 | 0.29 | 0.01 |
| 0.44 | —0.14 | 0.23 | 0.00 | 0.40 | 0.01 | —0.29 | —0.09 | 0.07 |
| 0.15 | —0.25 | 0.16 | 0.08 | 0.02 | —0.27 | —0.19 | 0.03 | 0.13 |
| 0.07 | 0.10 | —0.11 | 0.19 | —0.21 | 0.42 | —0.01 | 0.09 | 0.15 |
| 0.15 | 0.44 | 0.01 | —0.06 | —0.33 | —0.21 | 0.11 | —0.04 | 0.15 |
| 0.23 | 0.01 | —0.11 | —0.08 | —0.52 | 0.33 | —0.05 | 0.12 | —0.02 |
| 0.17 | 0.09 | —0.04 | 0.05 | —0.80 | —0.09 | 0.12 | 0.25 | —0.12 |

ni advance — to respond with maximum velocity to the imperative signal of which the reduction of reaction time is an expression too.

Proceeding from our results the assumption is warranted that certain correlation exists between reaction time and mechanisms of preliminary preparation for the forthcoming voluntary movement. This correlation shows individual differences, and is most probably determined by the tactics adopted by the subjects in fulfilling the task assigned. The fact that a correlative dependence between reaction time and amplitude changes in H-reflex is established in more than half of the subjects during the various intervals after the warning signal, gives us sufficient reason to draw the above conclusion.

## REFERENCES

1. Гериловски, Л., Ц. Цеков. Труды международного симпозиума «Переработка зрительной информации и регуляция двигательной деятельности», 1969, изд. БАН, 1971, 397—401. — 2. Пальцев, Е. И., А. М. Эльнер. Биофизика, т. XII, 1967, в. 1, 142—147. — 3. Цеков, Ц., Л. Гериловски. Зависимост между латентния период на двигателната реакция и амплитудата на Н-рефлекс при фиксиран период на очакване. Първи конгрес на дружеството по физиологични науки, 10—14. XI. 1970, София, р. 270. — 4. Цеков, Ц., Л. Гериловски. Трудове на V научна сесия МФ—Варна, св. I, 1974, 72—75. — 5. Цеков, Ц., Л. Гериловски, И. Златаров. Сб. IV национална конференция по спортна медицина и лечебна физкултура, св. I, 1971, 34—38. — 6. Requin, J. *Acta psychologica "Attention and Performance II"* (Ed. W. P. Koster), 1969, 30, 358—367. — 7. Semjen, A., M. Bonnet, J. Requin. Relation between the time course of Hoffmann reflexes and the foreperiod duration in a reaction time task, II International Symposium of Motor Control, Varna, X, 1972.

## ЗАВИСИМОСТЬ МЕЖДУ ВРЕМЕНЕМ РЕАКЦИИ И АМПЛИТУДНЫМИ ИЗМЕНЕНИЯМИ Н-РЕФЛЕКСА, ЭВОКИРОВАННОГО МЫШЦАМИ АГОНИСТАМИ ПРЕДСТОЯЩЕГО ПРОИЗВОЛЬНОГО ДВИЖЕНИЯ ПРИ ФИКСИРОВАННОМ ПРЕДВАРИТЕЛЬНОМ ПЕРИОДЕ, РАВНОМ 1000 МС

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РЕЗЮМЕ

Исследована корреляционная зависимость между временем реакции и амплитудными изменениями Н-рефлекса, тестующего моносинаптическую рефлекторную возбудимость будущих агонистов предстоящего произвольного движения на сегментном спиномозговом уровне. Опыты проведены в условиях фиксированного предварительного периода, продолжительностью в 1000 мс. Лица отвечали с максимальной скоростью на второй из двух идентичных световых сигналов. Первый из них был предупреждающим, а второй требовал двигательного ответа.

Обнаружена индивидуально различная по времени и значимости, преимущественно прямая корреляционная зависимость между временем реакции и амплитудными изменениями Н-рефлекса у 8 из исследованных 14 лиц.

В заключение принимается, что связь между реакционным временем и механизмами редварительной подготовки к предстоящему волевому движению является индивидуально различной и, вероятно, определяется тактикой лиц при выполнении поставленой задачи.