

## DEPENDENCE BETWEEN REACTION TIME AND H-REFLEX AMPLITUDE CHANGES EVOKED BY A MUSCLE FUTURE AGONIST OF A VOLUNTARY SIMULTANEOUS PLANTAR FLEXION OF BOTH FEET

Tz. Tzekov, S. Tzekov

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Some electrophysiological phenomena at different levels in the central nervous system are described during preparation for a voluntary movement. Under conditions of a simple motor task with warning signal, Kornhuber et Deecke (1965) observe the appearance of the so-called Bereitschaftspotential at cerebral level. During the expectance foreperiod of the order of some seconds, this potential has two components (6, 9, 11) differing in their latency and topography. The second component has a greater amplitude with shorter reaction times (6, 11). On the other hand, Walter et al. (1964) describe the so-called contingent negative variation or expectancy wave by means of an original method at cerebral level during an expectancy foreperiod equal to one sec. Contingent negative variation depends on signal characteristic, on the presence and quality of the response to the 2<sup>nd</sup> signal as well as on the psychophysiological state of the experimental individual. According to Tecce (1972) and other authors, expectancy wave is related to different cerebral structures.

At spinal cord level under the conditions of a task with a simple reaction time with warning signal when expectancy foreperiod is equal to one sec, Requin (1969) and Gerilowsky et Tzekov (1971) establish changes of monosynaptic reflectory excitability tested by means of T- or H-reflexes. These changes characterized as foretuning depend on the participation of the muscle by means of which they are tested in the forthcoming voluntary movement. They are best expressed when reflexes are evoked by muscles future agonists of the movement (7).

However, the importance of these phenomena for the performance of the task by the experimental person is not definitely clarified yet.

In the present work which is a detail of more comprehensive investigations in this field we decided to study the dependence between reaction time related with a series of psychophysiological processes at the level of cerebral cortex and H-reflex amplitude changes giving us a certain idea of motoneuronal pool excitability at spinal cord level in a task for simultaneous lifting of both heels. An attempt was made to clarify the specificity or universality of the character of the aforementioned dependence.

### Material and methods

The experiments were carried out with young practically healthy individuals aged between 22 and 25 year. They were sitting tranquilly on a chair in a dark room and responded according a preliminary instruction with maximal speed to impulse lamp light signal through red filter. Two experimental series were performed. In both cases, motor response was a simultaneous lifting from

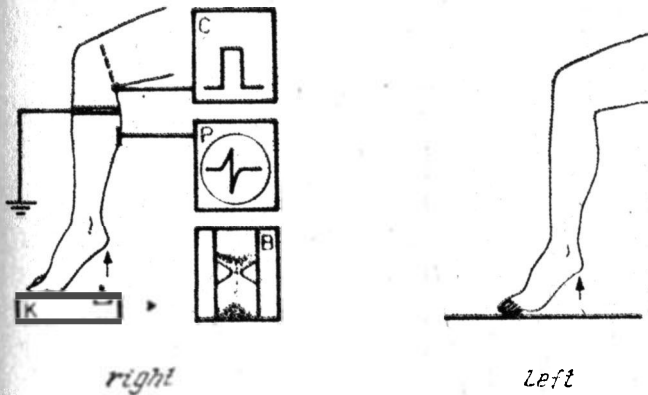


Fig. 1. Schema of the first experimental set.

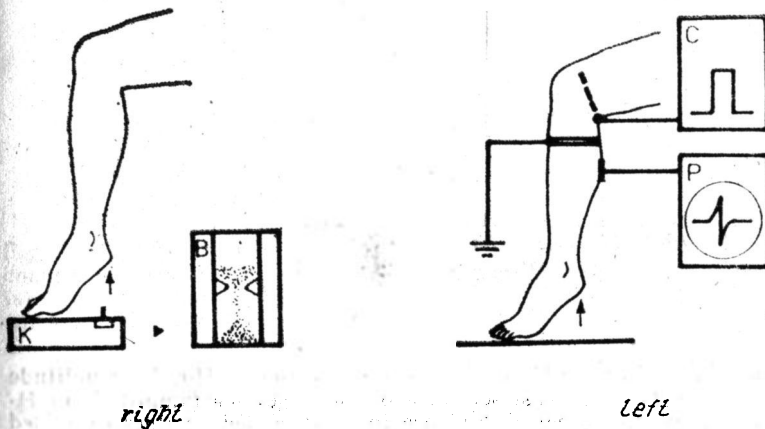


Fig. 2. Schema of the second experimental set.

the floor of both heels. Button for reaction time reading was set under the right heel in both series. The differences between the single series consisted in the following: in the first series, H-reflex was evoked from the lateral belly of m. gastrocnemius of the right leg while in the other series, it was evoked from the lateral belly of m. gastrocnemius of the left leg. Reaction time was measured by frequency meter ChS-2 which was started simultaneously with the light

signal requiring motor response and then was stopped by right heel lifting from the button. H-reflex was singly evoked for every light signal. The rectangular irritating impulse was 1 msec long. It was presented from Disa multistim through an isolating transformer on n. tibialis in the popliteal fossa of the corresponding leg. Taking pictures of reflexes was done by a Cossor film camera

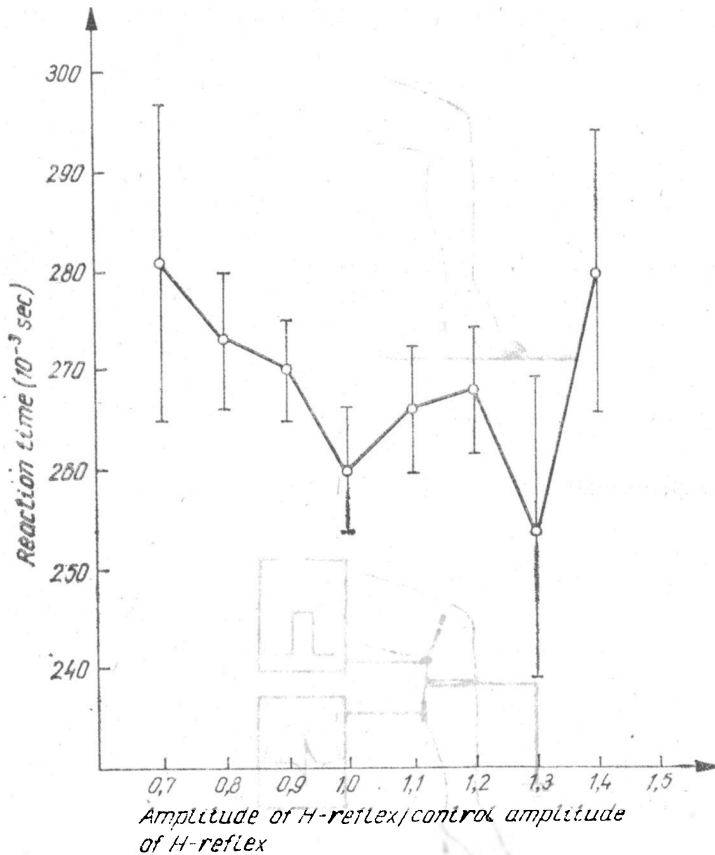


Fig. 3. Mean reaction time values of four subjects expressed as function of H-reflex amplitude changes evoked by the lateral belly of m. gastrocnemius of the right leg (amplitude of H-reflex towards amplitude of control one). Confidence interval of mean values expressed by vertical lines in every point is calculated at  $p = 0.05$ .

towards Disa universal indicator type 51B00. H-reflexes were with monopolar leads. One-day signal program was divided into three blocks of 40 light signals each. Prior to beginning and after every block H-reflex was fourfold evoked without presentation of light signals and, therefore, without any motor response. The mean amplitude of these H-reflexes was considered a control H-reflex amplitude at rest. Amplitudes of H-reflexes evoked with every corresponding light signal were compared with the amplitude of this control H-reflex. Then,

their decrease or increase was read and demonstrated as ratio in figures. Reaction times were grouped according to the increase or decrease of the corresponding H-reflex. Results were processed after the method of variation analysis. Diagrammatically, both experimental series are presented on fig. 1 and fig. 2.

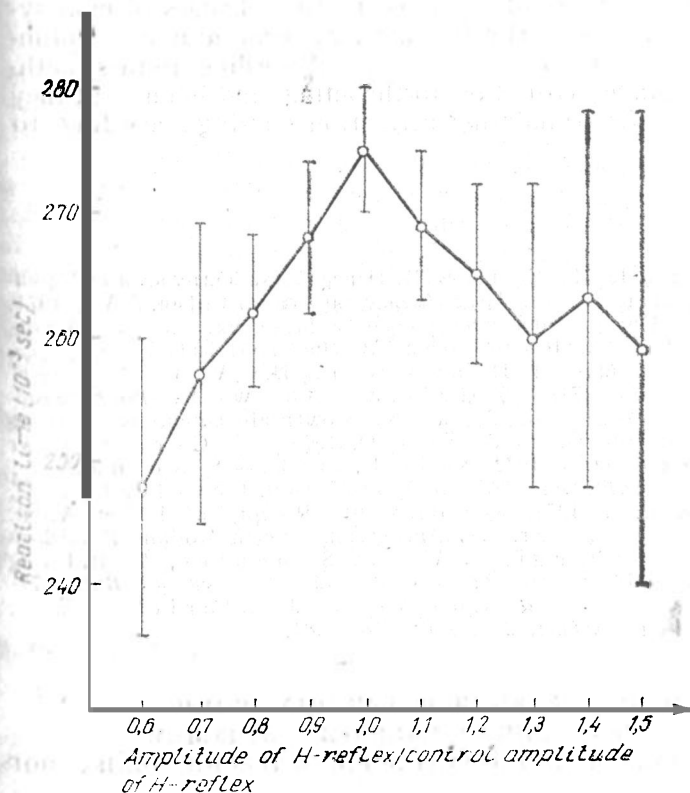


Fig. 4. Mean reaction time values of six subjects expressed as function of H-reflex amplitude changes evoked by the lateral belly of *m. gastrocnemius* of the left leg (amplitude of H-reflex towards amplitude of control one). Confidence interval of mean values expressed by vertical lines in every point is calculated at  $p = 0.05$ .

## Results and discussion

Results obtained are demonstrated on fig. 3 and fig. 4. One can see that there is a dependence between reaction time and H-reflex amplitude changes. However, it varies in the two experimental series. In other words, dependence has a specific character determined by the leg from which H-reflex is evoked during simultaneous lifting of both heels and when reaction time is measured by the button under the right heel. These results are in concordance with other data (2) according to which on the background of a general non-specific H-reflex amplitude increase (when H-reflexes are evoked from numerous muscles) there is a stronger expressed increase of the amplitude of the H-reflex evoked

from a muscle agonist to forthcoming voluntary movement. These data were obtained under conditions of a simple motor task with warning signal in the duration of reaction time. At the same time, T-reflex amplitude also undergoes characteristic changes when tested under more complex experimental conditions (4). Therefore, we are not entirely unjustified to say that we do not agree with the opinion of other authors (3) who accept that changes of monosynaptic reflectory excitedness tested by H-reflex prior to performing of a voluntary movement does not possess any specific character. According to these authors, these changes are not related with the forthcoming movement but they are determined by a non-specific stimulating activation passing according to a typical startle reaction.

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#### ЗАВИСИМОСТЬ МЕЖДУ ВРЕМЕНЕМ РЕАКЦИИ И АМПЛИТУДНЫМИ ИЗМЕНЕНИЯМИ Н-РЕФЛЕКСА, ВЫЗВАННОГО МЫШЦЕЙ — БУДУЩИМ АГОНИСТОМ ВОЛЕВОЙ, ОДНОВРЕМЕННО ПЛАНТАРНОЙ ФЛЕКСИИ ОБЕИХ НОГ

Ц. Цеков, С. Цеков

#### РЕЗЮМЕ

Исследования проведены в двух опытных постановках на молодых людях в возрасте от 22 до 25 лет. Они сидели спокойно на стуле в темной комнате и отвечали с максимальной скоростью на световой сигнал импульсной лампочки через красный фильтр, поднимая одновременно с потолка пятки обеих ног. Кнопка для установления времени реакции в обеих сериях находилась под пятой правой ноги. При первой серии Н-рефлекс вызван латеральной головкой икроножной мышцы правой ноги, а при второй серии — головкой икроножной мышцы левой ноги. Эвокированный ответ мышцы вызван одновременно с подачей светового сигнала однократно для каждой мышцы. С целью установления зависимости время реакции сгруппированы в зависимости от уменьшения или увеличения амплитуды соответствующего им Н-рефлекса по отношению к амплитуде контрольного Н-рефлекса, вызванного в покое без подачи светового сигнала.

Кривые, обозначающие зависимость между временем реакции и амплитудными изменениями Н-рефлексов в обеих сериях имеют неодинаковую форму. Это дает основание автором считать характер выраженной зависимости специфическим. При этом исследовании такая зависимость является результатом не только характера движения, но и ноги, которой вызывается Н-рефлекс при устанавливании временем реакции лишь при поднятии пятки одной из двух ног.