The influence of fast versus slow movements on response related brain potentials extracted by the CDA-method

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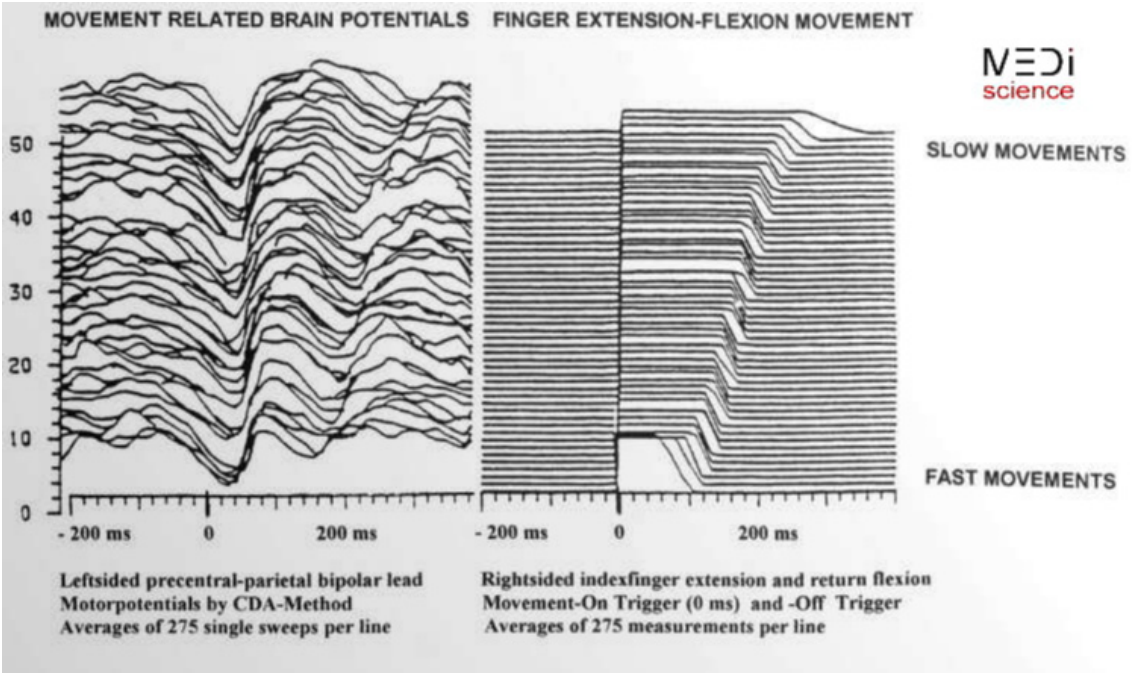

The figure above shows a perfect 1:1 parallel association between peripheral events and brain events. Such a connection is demonstrated for the first time in human neurophysiology by means of noninvasive electrophysiological methods. The figure is taken from the monograph on "The predictive brain. Prediction theory of conscious behavior" (in preparation) and shows the association between movement duration and the simultaneously ongoing parieto-precentral motor correlated brain potentials extracted by CDA (Crossed Double Averaging).

The movement in all cases of a fast or a slow movement was a right sided indexfinger extension and return flexion movement. The movement was the response to the frequent auditory stimulus (800 Hz, 65 dB, 40 ms, 85%) during a P3-oddball Go/NoGo reaction time paradigm (Bernoulli order, random ISI 1.1 to 4.1 sec). The subjects were instructed to respond to the frequent (Go-) stimulus (800 Hz), but not to the rare (NoGo-) stimulus (1400 Hz). They were supposed to lift the right sided indexfinger and to return the finger immediately back to the initial „readiness"-position as Go-reaction. The movements gave rise to extension onset and flexion offset flags. No instruction was given with regard to the speed or duration of the response movement, any difference in movement duration appeared spontaneously.

From 24 subjects a total of 13.750 Go-reactions was collected. This data pool was utilized to create by means of the on- and offset flags 50 classes each constituted by 275 reactions with a rather similar duration of the response movement. Per class an average over the 275 reactions was established. In terms of the movement onset and offset flags the average duration of the movement per class was displayed (see right half of the figure showing the increasing average of movement duration from bottom to top). The onset flags in the in the right half of the figure always are indicating the beginning of the response movement (0 ms). The average of the offset flags were influenced by the variance of the movement duration within either class, thus resulting per class in oblique bounds due to the slightly variable movement offsets.

The left sided EEG signals depicted by bipolar precentral-parietal leads (F3-P3, single sweep time 912 ms, 612 scans per sweep) and appearing in parallel with the response movement of the right sided indexfinger were averaged in the same order like the peripheral reaction movements:

according to the 275 instances of reaction movements with very similar movement duration per class the simultaneously collected brain signals were taken to establish per class the averaged brain potentials. The extraction of the reaction correlated motor potentials of the brain by means of CDA followed the guidelines out-lined in Schenk & Zerbin (1986), in Schenk (1988) and in the internet publication of Schenk & Schenk (2002, **www.MEDIscience.de**). The result is shown on the left half of the figure with the brain potentials due to increasing movement duration from bottom to top. The CDA-extracted motor potentials are perfectly indicating the increasing duration of the movements which are shown on the right half of the figure. In summary this figure displays a strong parallelism between brain and peripheral events. The precentral-parietal brain potentials shown in the figure are supposed to display correlates of the top down movement control mechanism.

Keywords: P3 paradigm, selective stimulus response behavior, reaction correlated CDA-potential, CDA-motor potential, speed of movement, precentral-parietal top down control, motor prediction, association of brain and peripheral activity.