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The 0.1 Hz-component of Heartrate Variability as an Indicator of Mental Strain in Tasks with Different Time Restrictions

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The 0.1 Hz component of heartrate variability (HRV) is considered an attractive and promising measure of mental strain and recently this measure has been used for analyzing mental workload in practical situations (e.g. in HCI). However, systematic and comprehensive studies investigating the psychometric properties of this measure are still missing. Based on a closer inspection of the relevant literature and some empirical data severe doubts concerning the validity of this measure have been raised (NICKEL et al., 1998).

Based on recent research where the 0.1 Hz component of HRV as a measure of mental strain showed unacceptable sensitivity and diagnosticity (NICKEL & NACHREINER, 2000), the aim of the present study was to investigate probable effects of pacing (i.e. time pressure) experimentally. Modified tasks of the AGARD-STRES battery were used to induce different levels of pacing (self- vs. machine-paced). The tasks were presented to 10 subjects in a systematically varied order. HRV in the frequency domain and its spectral energy in the midfrequency band (0.07 Hz – 0.14 Hz) was calculated. Additionally performance measures and perceived task difficulty were recorded.

Statistical analysis of the 0.1 Hz component of HRV data show a systematic effect for the pacing condition but neither an effect for different types of load nor an effect of time into session or sequence of task order. Furthermore, tasks with comparable cognitive demands but under different pacing conditions lead to different effects in the spectral energy in the midfrequency band. Analyses of the performance data and the perceived difficulties moreover show a systematic effect for different types of tasks. Our findings thus support the hypothesis that the 0.1 Hz component of HRV indicates emotional strain (or stress reactions) or general activation (e.g. through time pressure, anxiety) instead of mental or especially cognitive strain.

In conjunction with other recent findings concerning the validity of the 0.1 Hz component of HRV as an indicator of mental workload (MWL) our results strongly suggest that this indicator does not meet conventional psychometric criteria to be used in legal or agreed assessments of MWL and particularly not for practical purposes, where some occupational risks may be at stake.

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