ORIGINAL ARTICLE

Effect of Arithmetic Mental Task on Short Term Measurement of Heart Rate and Heart Rate Variability

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ABSTRACT

Purpose of the study

Heart rate(HR) and Heart rate variability(HRV) are two of the most widely known physiological measures for assessing mental workload. In this study the effect of a simple arithmetic mental task on HR and HRV in a group of ten young volunteers was investigated.

Material and Methods

One hundred and fifty numbers (range 0-29) were presented visually on a 14"CRT computer screen one at a time for 2 secs. One third of the numbers were asterix(*) marked.Subjects added these numbers mentally and told the sum at the end of experiment which continued for 5min. HR was recorded during 5min rest before the test and while performing the mental task. Time and frequency domain analysis were carried out.

Results & Conclusions

Results showed that HR increased significantly while performing mental task with decrease in both low frequency(LF) and high frequency(HF) components. No significant changes in LF/HF ratio and time domain component were observed. The decrement in LF component during mental task may be explained as the influence of parasympathetic efferent nerves.

Key words: *Heart rate, workload, mental processes, heart physiology*

INTRODUCTION

Mental workload is an invasive topic in recent times and it represents a subject of increasing interest. As modern technology imposes more cognitive demand upon us than physical demands in many work environments, the understanding how mental workload affects the performance is critical.A number of measurement techniques for mental workload are available. Among those, the main categories of workload measures are: primary task performance; secondary task performance; physiological measures and subjective rating.

Physiological measures are many and varied. The physiological method generally involves the measurement and data processing of one or more variables related to human physiological processes. For instance, various researchers have used respiration[1, 2] heart rate and heart rate variability [3, 4, 5] brain-evoked potentials[6], electro dermal response[1], eye movements and pupillary responses[7] as indices of mental effort. These measures offer advantages such as continuous monitoring of data; greater sensitivity and that they do not interfere with primary task performance.Among these parameters, heart rate (HR) and heart rate variability (HRV) have be en considered as most common, sensitive and authentic measures.[3, 4] In addition, unlike other parameters HR and HRV can be easily used in field condition and do not require any sophisticated instrument or technology.

Heart rate has been implicated in the measurement of workload[8] and its relation to mental effort is ambiguous[9]. In general, increases in heart rate are found with increased mental demands of the task. Tonic heart rate is activated by the sympathetic branch of the autonomic nervous system and responds to a wide range of influences. In one of the study Zwaga[10] found that HR decreased with anticipation stress.

In case of HRV, studies performed so far show diverse and in many cases opposite findings. Jex and Allen (1970)[11], Kalsbeek (1973)[12] found that HRV decreased as mental load increased. It was hypothesized that "concentration of attention" causes reduction in HRV. Spyker et al (1971)[1] found correlations of the R-T interval with workload. Stackhouse (1973)[13] found that HR and HRV measures were correlated with performance in precision hover experiments. There is evidence that variations in workload may produce change in the midfrequency (mainly 0.10 Hz) respiratory band component, which has been more consistently found to be sensitive to demands for increased mental effort.[3]

In contrast, Mobbs et al (1971)[14] and Sherman (1973)[15] in their studies found no systematic relationship between mean heart rate and task difficulty. Similarly, they found no relationships between HRV and task difficulty. Luczak and Laurig (1973)[16] demonstrated that only certain measures of HRV would produce statistically significant changes as a function of operator loading. Sayers (1973)[17] found that HR and HRV were unreliable measures of

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