

The Use of Near-Infrared Spectroscopy in Measuring General Autonomic Arousal

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Introduction

The use of electrodermal activity (EDA) has become the most widely used measure in psychophysiological studies and has been identified as perhaps the best general index of autonomic activity [Dawson *et al* 1990]. Recent work in near-infrared (NIR) technology, however, has made possible the development of another psychophysiological recording device that may match EDA as a general index of autonomic arousal.

Method and Results

The current study employed a well-established learning procedure commonly used in psychological studies to test the utility of the NIR recording device and to track its readings in real-time in relation to a concurrent measure of EDA during the presentation of a series of stimuli to the subject in accordance with a respondent conditioning paradigm [Roche *et al* 1997]. The NIR optical signal gives an indication of the vascular response, from which heart rate variability (HRV) and blood pressure fluctuations can be extracted. The optical signal was de-trended and low-pass filtered below 0.75Hz to observe the slow vascular response. In order to resolve HRV, the de-trended optical signal was band-pass filtered between 0.75Hz and 1.5Hz, and the time between each pulse was determined. An EDA response was defined as the maximum decrease in skin resistance (i.e., inversely related to arousal) from the level of skin resistance to at the time of stimulus presentation within 5 s of stimulus onset (see Roche & Barnes, 1997).

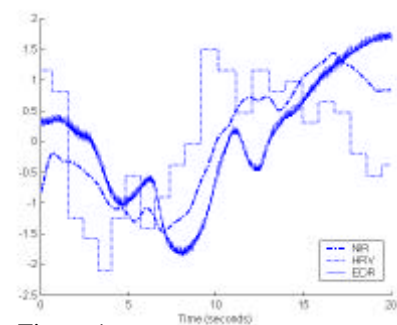


Figure 1: Responses due to loud aversive noise

Discussion

Patterns of EDA typically associated with a stress response were observed when stimuli followed by (or associated with, by the subject) a loud aversive noise were presented to the subject. A decrease in the detected light intensity was simultaneously observed in the NIR data. HRV extracted from the optical signal also revealed an increase in heart rate within seconds of the onset of the stimulus.

Conclusions

EDA is thought to provide a simple gauge of the level and extent of sympathetic activity. The results of this study show that the cerebral hemodynamic response found using NIR techniques could also be used as a psychophysiological measure for the same general psychophysiological purposes. NIR technology also has the benefit of being non-invasive, portable, does not require the use of gel, and allows for the extraction of multiple dependant measures of nervous system activity.

References:

Dawson, M. E., Schell, A. M., & Filion, D. L. (1990). The electrodermal system. In J. Cacioppo & L. G. Tassinory (Eds.), *Principles of psychophysiology. Physical, social, and inferential elements* (pp. 295-324). New York: Cambridge University Press.

Roche B, Barnes D. A transformation of respondently conditioned stimulus function in accordance with arbitrarily applicable relations. *Journal of the Experimental Analysis of Behavior*, 67:275-301,1997.