



Aspects of Short-Term HRV Analysis in Psychological Research

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Over the past two decades, the analysis of heart rate variability (HRV), originally anchored in the medical domain, has been gaining popularity in psychological research. Despite this development, many questions regarding aspects of HRV measurement and analysis as well as their psychological significance remain unsolved. The aim of the present project is to take a closer look at methodological characteristics of short-term HRV analysis in psychological research. In detail, I will address the following questions: (1) To what degree have the established standards and guidelines of HRV measurement and analysis been successfully implemented in psychological research? (2) How reliable are HRV measurements? (3) To what extent does the increasing variety of measuring devices and software solutions influence calculated HRV parameters?

(1) Standards for the HRV measurement were published almost three decades ago (Task Force, 1996). Nevertheless, it might be that current research has not yet fully adopted these standards. A comprehensive review of the status quo of HRV research, examining studies from 2000 - 2013, showed a great deal of methodological heterogeneity, both in measurement and in subsequent analyses and interpretations (Uhlir et al., 2017). However, publications from the year 2013 are now a decade old - a time-period in which HRV research has made a lot of progress. In particular, the last 5 to 6 years have seen an increase in publications addressing good scientific

practice in HRV research and recommendations for improving the quality of HRV analyses (including Pham et al., 2021; Catai et al., 2020; Vila et al., 2019; Laborde et al., 2017). Therefore, my aim is to review the existing HRV research in the psychological field with regard to the implementation of the currently accepted standards. The time span investigated is extended to the last 3 decades, to uncover the development and current trends of the research field. In this way, it is possible to identify existing challenges and opportunities for improvement.

(2) Another important methodological aspect of HRV research is the reliability and thus reproducibility of measurements. Thus far, there is no systematic overview that integrates the existing findings in this vein. My goal is to provide a meta-analysis investigating the reliability of short-term HRV measures in order to determine whether and to what extent the replicability of HRV studies is limited in order to identify possible approaches for improvement.

(3) A third goal of the current project is to investigate the influence of different measuring devices and software solutions on the calculated HRV parameters. In the context of constant technological progress, an increasingly wide variety of measuring devices (both stationary and mobile variants) as well as different software solutions for analyzing the recorded parameters are becoming available in the field of HRV research. However, given the intention of publishing standardized and thus replicable and comparable studies in the near future and extracting standard values from them, it is essential to know whether and to what extent the hardware and software used in the analysis has an influence on the calculated parameters.

Literature

Catai, A. M., Pastre, C. M., de Godoy, M. F., da Silva, E., de Medeiros Takahashi, A. C., & Vanderlei, L. C. M. (2020). Heart rate variability: are you using it properly? Standardisation checklist

of procedures. *Brazilian journal of physical therapy*, 24(2), 91-102.

<https://doi.org/10.1016/j.bjpt.2019.02.006>

Laborde, S., Mosley, E., & Thayer, J. F. (2017). Heart rate variability and cardiac vagal tone in psychophysiological research—recommendations for experiment planning, data analysis, and data reporting. *Frontiers in Psychology*, 8, 213.

<https://doi.org/10.3389/fpsyg.2017.00213>

Pham, T., Lau, Z. J., Chen, S. A., & Makowski, D. (2021). Heart rate variability in psychology: a review of HRV indices and an analysis tutorial. *Sensors*, 21(12), 3998.

<https://doi.org/10.3390/s21123998>

Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. (1996). Heart Rate Reliability: Standards of measurement, physiological interpretation, and clinical use. *European Heart Journal*, 17(3), 354-381.

Uhlig, S., Meylan, A., & Rudolph, U. (2017). A systematic review of short-term heart rate variability in psychological research: Toward unified methodological standards. Manuscript submitted for publication.

Vila, X. A., Lado, M. J., & Cuesta-Morales, P. (2019). Evidence based recommendations for designing heart rate variability studies. *Journal of Medical Systems*, 43(10), 311.

<https://doi.org/10.1007/s10916-019-1437-8>