

CROSSTALK

Last Word from Marek Malik, Katerina Hnatkova, Heikki V. Huikuri, Federico Lombardi, Georg Schmidt and Markus Zabel

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While we still very much regret that our opponents did not address the initially agreed topic, we are naturally pleased that notwithstanding this diversion the discussion triggered a large number of commentaries and responses.

As far as we can tell, nobody agrees with our opponents' view that there is nothing more to heart rate variability (HRV) than the underlying heart rate. Indeed, in our Rebuttal (Malik *et al.* 2019) we have already pointed out the deeply illogical nature of that argument. We are also pleased that nobody challenges our conclusion that HRV is a valid technology to estimate

the presence or absence of cardiovascular manifestations of autonomic reactions and responses. For a long time, this has indeed been a well-established methodology (see Cerutti & Sassi and Porta & Baumert in the accompanying CrossTalk Comments).

The use of HRV for autonomic tone assessment is evidently much less clear and much less established, as we also pointed out before. Moreover, judging by some of the responses, there is perhaps still some occasional confusion between the autonomic responsiveness and autonomic tone. As far as the relationship between HRV and autonomic tone is concerned, we fully agree with the discussion point (see Zaza in the Comments) that no HRV measure should ever be blindly interpreted as a universal indicator of vagal or sympathetic nerve traffic and that such blind interpretations have previously contributed to deeply erroneous conclusions. Whilst certain HRV-based approximations of autonomic tone and nerve traffic are possible, their appropriateness and validity depend on the experimental and other circumstances.

The problematic link between simple HRV measures and the autonomic tone assessment has been mentioned in the majority of the responses to this debate. This confirms the importance of non-invasive estimates of autonomic tone, reactions and reflexes which clearly go well beyond standard HRV (Boutagy & Sinusas, 2017; Steger *et al.* 2019). We can only hope that *The Journal of Physiology* will soon commission a detailed review of this wider field with all its

open conundrums as well as physiological and clinical advances and achievements.

References

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Additional information**Competing interests**

None declared.

Author contributions

All authors have approved the final version of the manuscript and agree to be accountable for all aspects of the work. All persons designated as authors qualify for authorship, and all those who qualify for authorship are listed.

Funding

This work was supported in part by the British Heart Foundation New Horizons Grant NH/16/2/32499.