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Letters to the Editor

Sir,

Recently an interesting paper on respiratory arrhythmia in porpoises, published in *Aquatic Mammals*, was brought to our attention (Kastelein & Meijler, 1989). For a long time we have been active in the field of analysis of heart rate variability and modelling of neurocardiovascular control in humans (Kitney & Rompelman, 1980, 1987). Therefore, we were highly intrigued by the phenomenon of respiratory sinus arrhythmia (RSA) in the aquatic mammal. On the basis of our experience we would like to give some comments.

The phenomenon of RSA is well known in humans. Although the authors make a comparison between the human and the animal's ECG, they fail to do so as far as RSA is concerned. Moreover, there is no reference to the vast amount of literature on human RSA. From the title of the paper this is something that could be expected more readily than a comparison of the ECG's. Several techniques have been discussed for the analysis of RSA (Rompelman, 1987). From a systems analysis point of view these techniques may be roughly divided into two approaches. In the first approach every respiratory activity (e.g. inspiration) is regarded as a single impulse like input and the reaction of the heart rate is investigated. The second approach makes use of the periodical character of the human respiration, and frequency response techniques are used to describe RSA in terms of amplitude and phase characteristics.

It has been observed that the respiratory activity of a number of aquatic mammals can be described in terms of bursts of periodic breathing activity separated by periods of breathhold during diving (Ridgway & Harrison, 1986; Lockyer & Morris, 1986). The number of periods may be just one or two, but also a number of up to 50 have been reported. In the case of a longer period of periodic breathing we could think of a frequency response type of analysis, whereas a very limited number of periods or one single period would lead to the analysis of the response to an impulse like stimulus. As we understand from the paper the latter approach has been chosen, however without any discussion of the kind just mentioned. Having decided implicitly for the impulse response type of analysis it consequently can be concluded that only one value of this response curve is given viz. 'heart rate first 10 seconds after respiration'. Describing a system's reaction to a sudden change in terms of one single observation seems to be rather inadequate. Furthermore, it is not made clear how heart rate is defined. It should be noted that 'rate' implies counting events during a certain time bin: the averaging epoch. This raises problems in a rapidly varying phenomenon as is the case in heart rate. In this paper this epoch nor its duration is mentioned. Maybe the rate in this case was defined as the reciprocal of the RR-interval ten seconds after the inspiration. The main issue here is the measurement of fluctuations in heart rate, a topic which has been thoroughly discussed in the literature (e.g. Rompelman *et al.*, 1976). By carefully reading the literature we think that an appropriate technique for the assessment of the heart rate response to respiration could have been selected resulting in a rather complete description in terms of the instantaneous heart rate as a function of time. Consequently the statistical significance of the results might be improved by averaging a number of these curves.

In conclusion, we feel sorry that a unique chance has been missed to accurately assess the response of heart rate to breathing in these aquatic mammals, which in our opinion is very well possible from the indeed unparalleled recordings made.

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References

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Sir,

We are very happy that our paper on the respiratory arrhythmia in Harbour Porpoises is also read outside the marine mammal society.

Dr Rompelman and Prof Kitney wonder why we do not refer to the large amount of available literature on respiratory arrhythmia in terrestrial mammals including man. There are two reasons why we omitted background information:

(1) The data presented in the paper were not the result of an organized research project in order to give an answer to a hypothesis. The data were collected during a project to develop electrodes that could be used to record the heart rate of Grey Whales in the field. During the testing of the electrodes the signal quality was evaluated and recorded. Those few recordings seemed of more interest than just for signal quality evaluations. We do not feel that data collected this way should be hidden in a vast amount of literature. We prefer that the data are used in a larger review paper which might well be written by the authors of the above letter to the Editor.

(2) Dr Rompelman and Prof Kitney are probably not familiar with the scope of the journal *Aquatic Mammals*, and the type of people and Institutions that are subscribers to it. The paper was written for a large audience which would benefit from the knowledge that an extremely strongly varying heart rate in dolphins is no reason to take medical actions.

The selection of the way to indicate the extent of the heart rate difference before and after a respiration was completely arbitrarily. The differences are the most extreme when comparing the average heart rate of the last 10 seconds before a respiration with the first 10 seconds after a respiration.

A large mount of statistics should be applied in future research projects of a different scope, which may benefit from the practical electrode designs that resulted from this project.

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