

# Reply to Padulo et al.: Jymmin, an easy-to-implement musical workout approach

Padulo et al. (1) comment on our recent PNAS article (2). Here, we give a response to each of their points and rebut each point. Their major concern seems to be that the musical feedback technology we used is too complex to allow for replication by other laboratories. We do not agree with Padulo et al.; rather, we are convinced that this paradigm, which has since also been used to examine other psychological effects (3), can be replicated quite rapidly with some experience in electroacoustic music and some knowledge about sensors and widely used music composition programs (such as Ableton, MaxMSP, Puredata, Cubase, etc.). Furthermore, extensive piloting of the Jymmin method with participants of all age groups indicates that effects of Jymmin are largely independent of individual musical taste so that, for example, elderly participants who usually didn't appreciate modern electronic music enjoyed creating the same type of music themselves during Jymmin. This suggests that the effects of Jymmin are probably not exclusive to certain compositions but can be evoked with a great variety of musical sounds and styles.

Subsequently, we address the other points of Padulo et al. as follows:

- i) They stress that a different maturation level affects perceived exertion. This is true, but is not relevant to our study because a within-subject design was used (every participant performed each condition and was her/his own control).
- ii) Padulo et al. argue that, despite counterbalancing, there might still have been un-

controllable fatigue effects, so that it might have been better to conduct each condition on a different day. First, it remains unclear why such fatigue effects should be uncontrollable. Second, as described in *Methods*, each condition lasted only 6 min (which is a short time for a sport activity), followed by a rather long 10-min rest between the different conditions. None of the participants complained about fatigue during or after the experiment.

- iii) We assume that the authors' comment on measurement reliability refers to spirometry: there are indeed plenty of reports addressing the validity and reliability of the applied spirometry equipment (4–6) under near-laboratory conditions (temperature and humidity were stable).
- iv) The authors question our use of the “ratio” approach, which might in their view impair repeatability. We thought it was the most appropriate parameter to index our research finding; thus, we think that other researchers might want to use the same approach.
- v) The authors' critique of the Borg scale refers to the calculation of heart rate from values of the Borg scales during pregnancy. Although none of our participants were pregnant, we also did not use the Borg scale for this cause but merely to assess the perceived exertion, for which

it can be assumed to be accurate (and is a widely accepted standard).

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**1** Padulo J, Maffulli N, Ardigo LP (2014) Signal or noise, a statistical perspective. *Proc Natl Acad Sci USA* 111:E1160.

**2** Fritz TH, et al. (2013) Musical agency reduces perceived exertion during strenuous physical performance. *Proc Natl Acad Sci USA* 110(44):17784–17789.

**3** Fritz TH, Halfpaap J, Grahl S, Kirkland A, Villringer A (2013) Musical feedback during exercise machine workout enhances mood. *Front Psychol* 4:921.

**4** Laurent CM, et al. (2008) Validity of the VmaxST portable metabolic measurement system. *J Sports Sci* 26(7):709–716.

**5** Perkins CD, Pivamik JM, Green MR (2004) Reliability and validity of the VmaxSTPortable metabolic analyzer. *J Phys Act Health* 1(4):413–422.

**6** Vogler AJ, Rice AJ, Gore CJ (2010) Validity and reliability of the Cortex MetaMax3B portable metabolic system. *J Sports Sci* 28(7):733–742.

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The authors declare no conflict of interest.

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