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Guiding athletes through heartrate and power based tasks

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Purpose:
Structured training usually consists of tasks with fixed intensities set by, for example, heart rate or power. Additionally, tests designed for monitoring changes in training status often require athletes to keep their heart rate within one or a few beats of a certain threshold. However, these tasks can be difficult to fulfil, especially for novice athletes and even harder when the boundaries for the targets are narrow. Nevertheless, for reproducibility it is important that tasks are executed in the best possible manner. This pre-study aims to investigate which visual aids can help athletes to achieve better accuracy in their tasks.

Methods:
In this study two variants of a novel visual feedback were compared to a classic design showing only numbers. Figure 1 depicts the three variants of the feedback. The first variant (a) visualises the target HR and deviation from it using a horizontal bar while the second variant (b) visualises the same using a Tachometer with the target centred in the middle. The 'classical design' (c) visualises the current heart rate or power using a plain number. In order to test the variants a smartphone app was created using the Pegasos-Framework (Dobiasch & Baca, 2016). The app recorded heart rate as well as power and transmitted them to a server in real-time.
The test used for the evaluation of the feedback variants is a modified version of the Lambert Submaximal Cycling Test (LSCT) (Lamberts, Swart, Noakes, & Lambert, 2009). The tasks were as follows six minutes at 60% of self-reported maximal heartrate ± two beats, six minutes at 80% ± one beat and three minutes at 90% ± one beat. This was followed by 90 seconds rest. After this a pop up window on the screens tells the participants their target power during the next three minutes stage. During this stage participants were asked to keep their power within ± 10 watts of the target power. This stage was again followed by 90 seconds rest on the bike.
Each participant completed three trials each with a different version of the feedback in a randomized order. After each trial participants were asked to out a questionnaire about the used feedback variant.

Results:
12 participants (8 male, 4 female. Mean ± SD; age: 33.13 ± 12.67 years, height: 178.75 ± 7.56 cm, body mass: 73.12 ± 10.97 kg) participated in the pre-study. Table 1 highlights the results from the heart rate based task. In order to account for the time needed to raise the heart rate to the desired level all measurements are taken starting from one minute into the stage. Two participants were excluded from this analysis due to non-adherence to the protocol or very low accuracy (< 20%). Furthermore, we analysed the relative time spent in the target zone. Due to technical problems, two further trials had to be excluded. Again, no significant differences between the feedback variants were found using a repeated measurements anova ($P > 0.05$). Table 2 shows the results from the power based task. Again, no significant differences were found when using a repeated measurements anova ($P > 0.05$).

Discussion:
Although differences between the variants are not significant it seems that for most of the investigated load levels one of the novel designs is favourable over the classical design. Nevertheless, it seems that there are large individual differences and no system works best for all. This, however, can finally be answered using the measurements of the currently ongoing study.

Table 1. Results for the heart rate based task. Numbers indicate mean relative amount of time in the target zone after measured starting after one minute until the end of the stage.

	N	All Stages	Stage 1	Stage 2	Stage 3
Bars	10	55.4% ± 20.3	60.2% ± 29.2	49.4% ± 16	56.5% ± 26.4
Numbers	10	55.3% ± 21.2	64.0% ± 25.3	48.8% ± 12.7	53.1% ± 30.7
Tacho	10	60.4% ± 16.4	71.4% ± 15	42.7% ± 21.5	67.0% ± 22.3

Table 2. Results for the power based task. Numbers indicate relative mean amount of time spent in the target zone.

	N	Full Stage	Minutes 2+3	First 30sec	First 45sec
Bars	10	59.8% ± 14.2	62.6% ± 14.5	75.3% ± 30	50.2% ± 20
Numbers	10	60.4% ± 18.7	64.3% ± 19.7	75.5% ± 32.9	50.3% ± 21.9
Tacho	8	62.3% ± 16.6	65.6% ± 16.3	75.7% ± 32.2	50.5% ± 21.5

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