Golf performance enhancement

by means of real-life neurofeedback training based on personalized event-locked EEG profiles

brainquiry

Presentation contents

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Pilot (1)

- Aim:

  investigate whether differences exist in EEG activity for successful vs. unsuccessful events

- Method:

  ‘Real-life’ measurement of the EEG during golf putting

- Outcome:

  recognizable and reproducable EEG patterns for successful and unsuccessful puts

Pilot (2)

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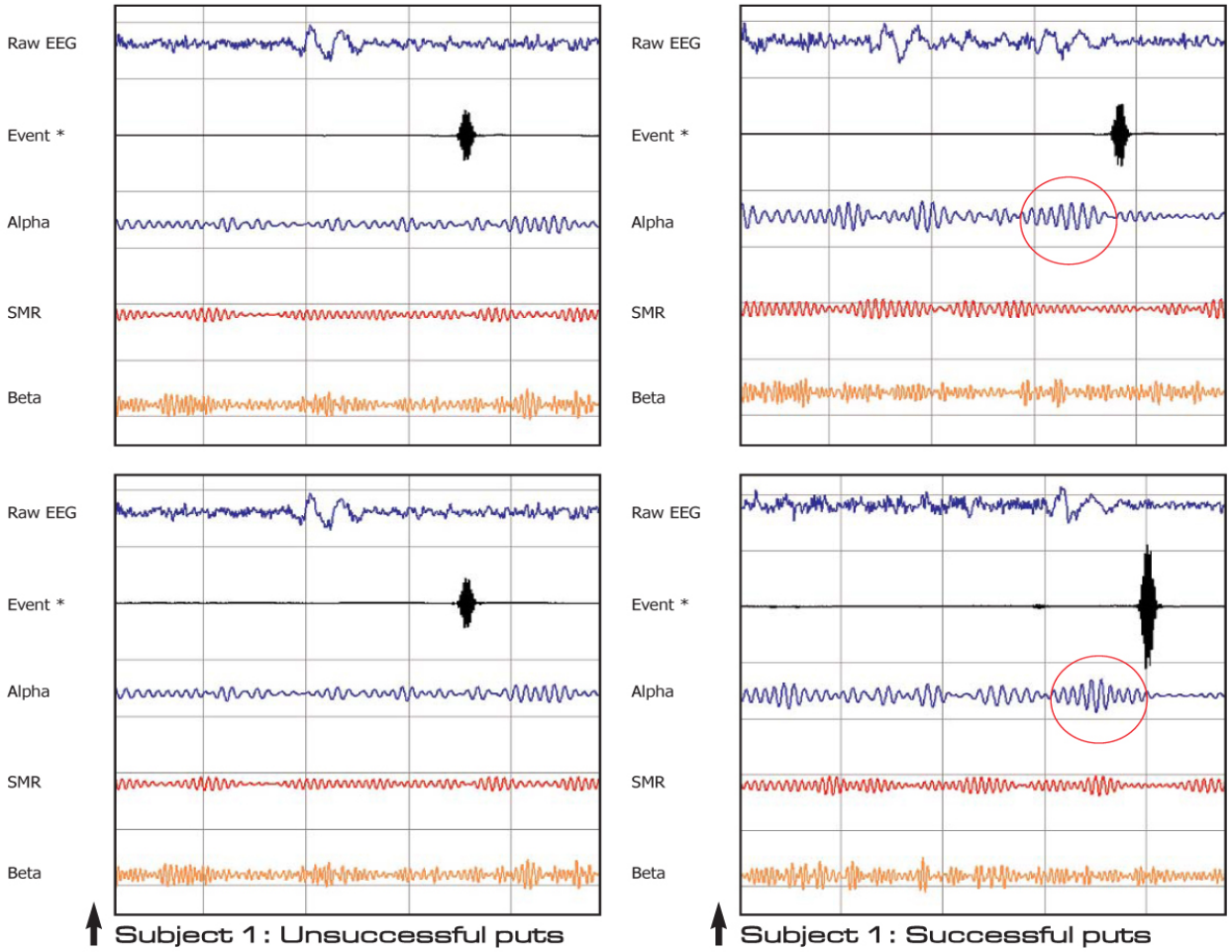

Difference in puts

In these pictures you can see the brain wave patterns of two unsuccessful and two successful puts of one subject. The brain wave pattern in the successful puts showed a clear burst of alpha before the ball impact.
During the unsuccesfull puts this was absent.

** The burst in this event is the ball impact.*

Study design

- 6 participants (handicap 12.3, SD 5.6)
- Assessment + 3 real-life neurofeedback training sessions
- On-course/indoors
- Recordings:
  - FPz against linked earlobes
  - event channel of ball impact
  - success scoring

Assessment procedure

- 50 % successful putting distance (PD_{50})
- 8 x 10 puts
- Event-locked averaging of the EEG frequency band amplitudes for successful vs. unsuccessful puts: *event-related EEG*
  - theta, alpha, low beta, beta;
  - alpha-1, alpha-2, beta-1, beta-2

Assessment results: Subject 1

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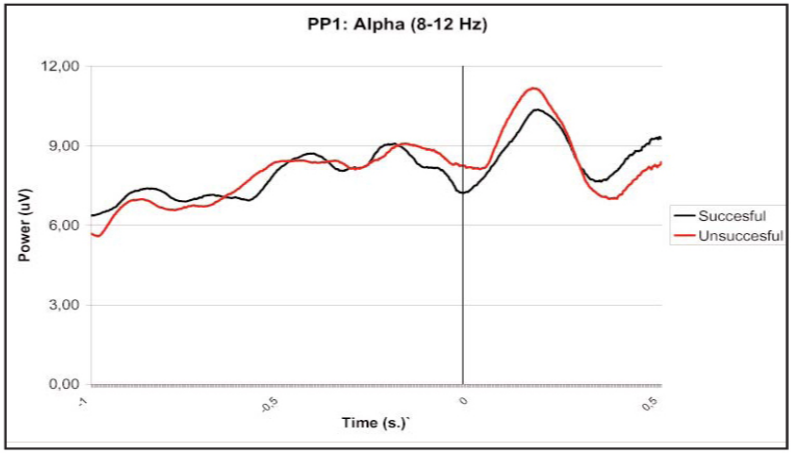
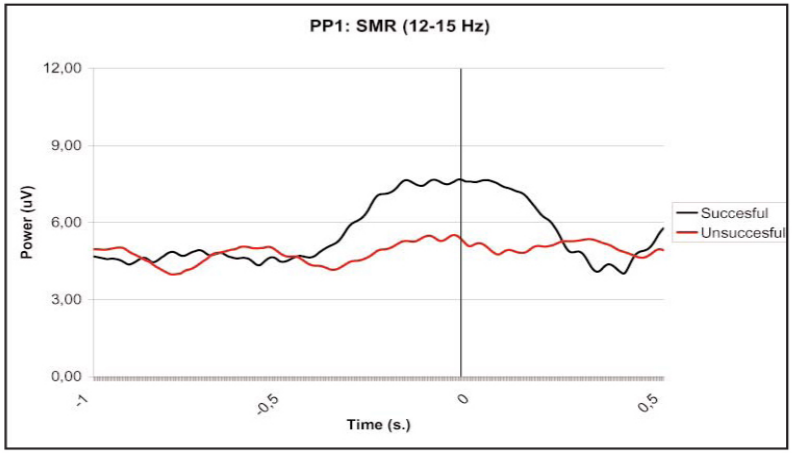
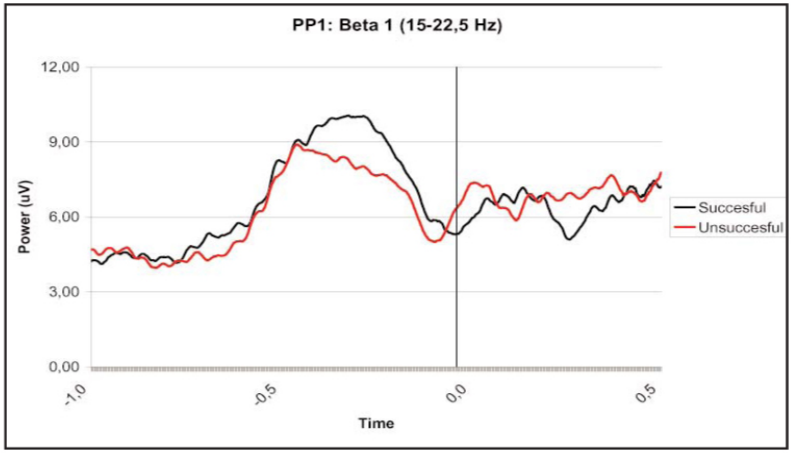
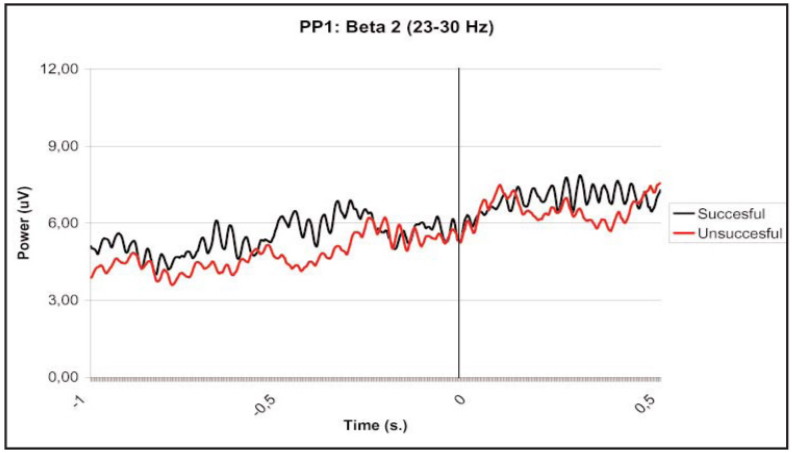




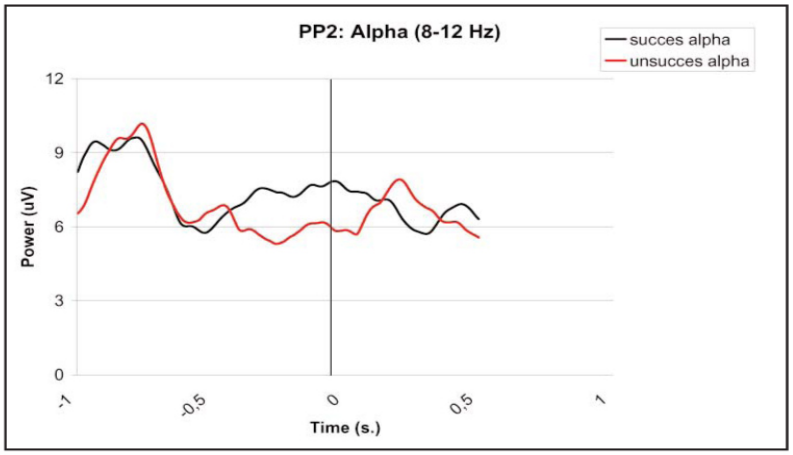


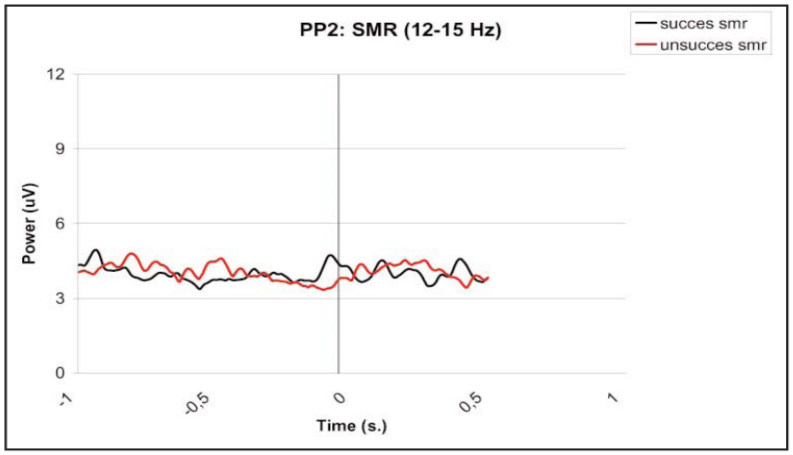


Subject 1

This subject shows a very clear pattern in SMR and Beta 1. There were no differences in the Alpha and Beta 2 ranges.

Assessment results: Subject 2

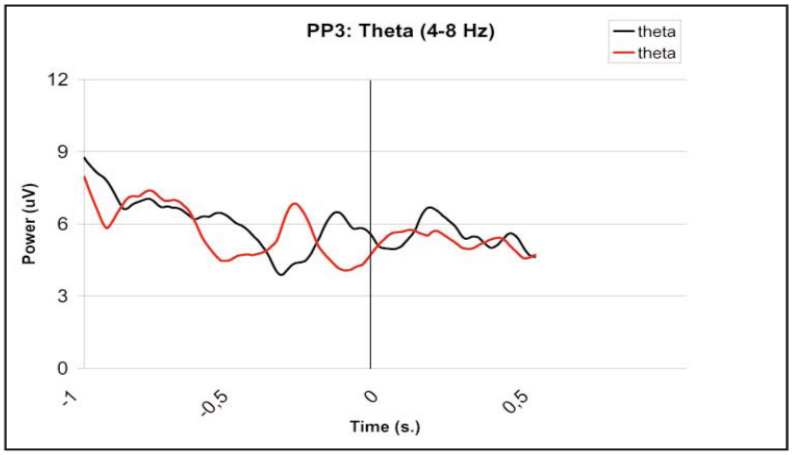


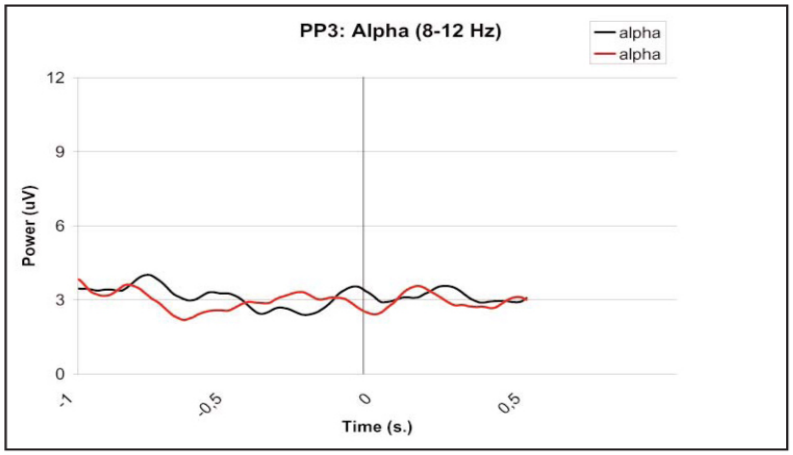


Subject 2

This subject shows a very clear pattern in Alpha and a small difference in SMR. There were no differences in the Beta 1 and 2 ranges.

Assessment results: Subject 3





Subject 3

This subject shows a shift in Alpha and Theta. There were no differences in the Beta 1 and 2 ranges which could be interpreted as a timing effect; e.g. the preperation started to early.

Training protocols

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- Personalized training protocols based on the individual event-locked EEG profiles
- Inter-rater reliability of 91 %

Subject	Theta	Alpha	SMR	Beta	Alpha 1	Alpha 2	Beta 1	Beta 2	EEG power: 2-42 Hz	imp check: 48-52 Hz	EMG: 42-60 Hz
AH	< 18	> 18	< 8	< 15					< 100	< 20	< 20
AV	< 15		> 6	< 9		> 6			< 100	< 20	< 20
EB	< 18			< 14	> 12				< 100	< 20	< 20
FK	< 15	< 10	> 8				> 10	< 8	< 100	< 20	< 20
HK	< 20	< 10	< 10	< 13					< 100	< 20	< 20
IW		> 25	< 9	< 10					< 100	< 20	< 20

Table 1. Reward and inhibit threshold settings during training (numbers are values in microvolts).

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Training procedure

- 4 x 80 puts from PD_{50} in an ABAB design
- Feedback condition (B):
  - continuous NoGo tone
  - ceasing (1.5 s) when in the optimal mental state for performance
  - eye-blink and EMG inhibits
- Perform put within 1.5 s from ceasing

Training results

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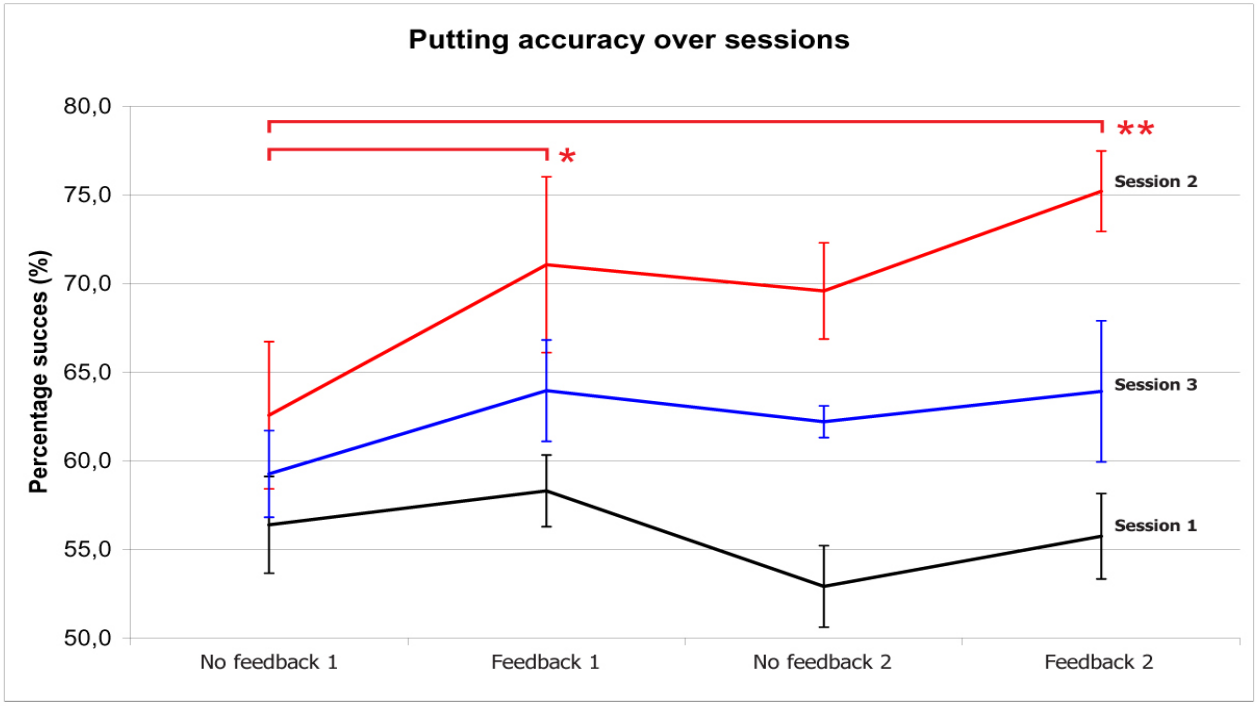

Putting accuracy

This figure clearly shows the effect of feedback during the golf putting. The feedback conditions clearly showed an increase in putting accuracy, and highly significant effects were found on session 2 with an increase of 10%.

Discussion

- Real-life neurofeedback
- Location
- Control group
- Sham feedback

Developments/future studies

- Longitudinal studies
- Golf professionals
- Other sports (rifling, bowling, darts, football, basketball, etc.)
- Clinical real-life NF