Reward modulates changes of corticomotor excitability induced by motor skill

KATHOLIEKE UNIVERSITEIT LEUVEN

BIOMEDICAL KINESIOLOGY

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INTRODUCTION

- Previous research has shown that monetary reward improves the acquisition and particularly long-term retention of a newly acquired motor skill in humans
- The physiological substrate mediating this effect is most likely dopamine (DA), a neuromodulator influencing cognitive, emotional, motivational and motor processes
- Primary motor cortex (M1) receives dopaminergic projections and an optimal level of DA improves neuroplasticity and consolidation of motor memories

HYPOTHESES

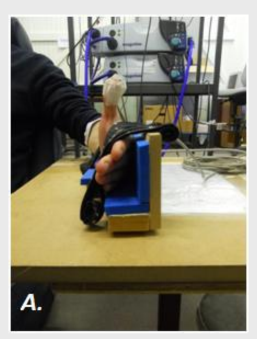
- Training under rewarded conditions should be more effective compared to training under punishment conditions
- We tested whether reward has also a positive effect on use dependent plasticity which is believed to serve as a model for studying long term potentiation (LTP) like plasticity in humans and whether this effect manifests at the behavioral and/or neural level

MATERIALS & METHODS

- **SUBJECTS:** N=28 (age18 – 29, 15 female, 4 left handed)
- **TASK: Perform ballistic thumb movements (thumb flexion) as quickly as possible** (Fig. 2)
  - **REWARD: Gaining money (0 up to 25 Euro)**
  - **PUNISHMENT: Losing money (50 down to 25 Euro)**
- **Transcranial magnetic stimulation** (TMS) (Fig 1) was used to determine:
  - -corticomotor excitability of the thumb flexor (Single Pulse)
  - -Intracortical Inhibition (SICI) (Double Pulse)
- **PROTOCOL**

DAY 1							DAY 2	DAY 7
BASELINE	BEHAVIORAL TRAINING	POST 1	POST 2	POST 3	POST 4	BEHAVIORAL RETENTION	BEHAVIORAL RETENTION	BEHAVIORAL RETENTION
TMS 20 Single 20 Double	TASK 10 Blocks 20 thumb movements/Block	TMS 20 Single 20 Double	TMS 20 Single 20 Double	TMS 20 Single 20 Double	TMS 20 Single 20 Double	TASK 1 Block	TASK 3 Blocks	TASK 3 Blocks

1 TMS

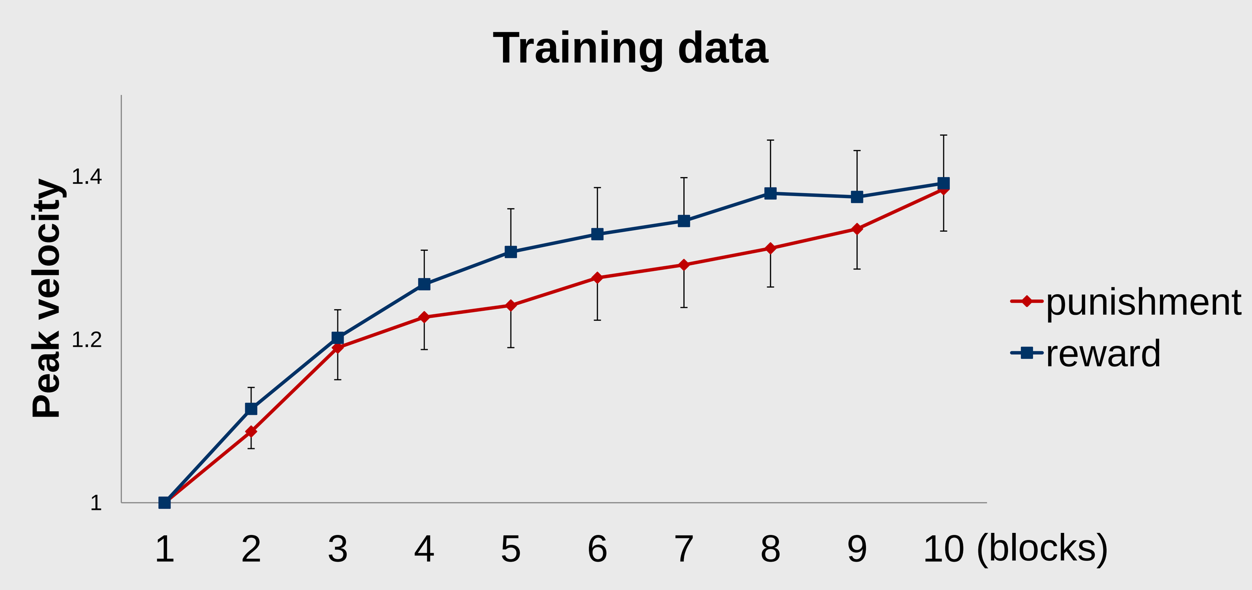


2 Flexion

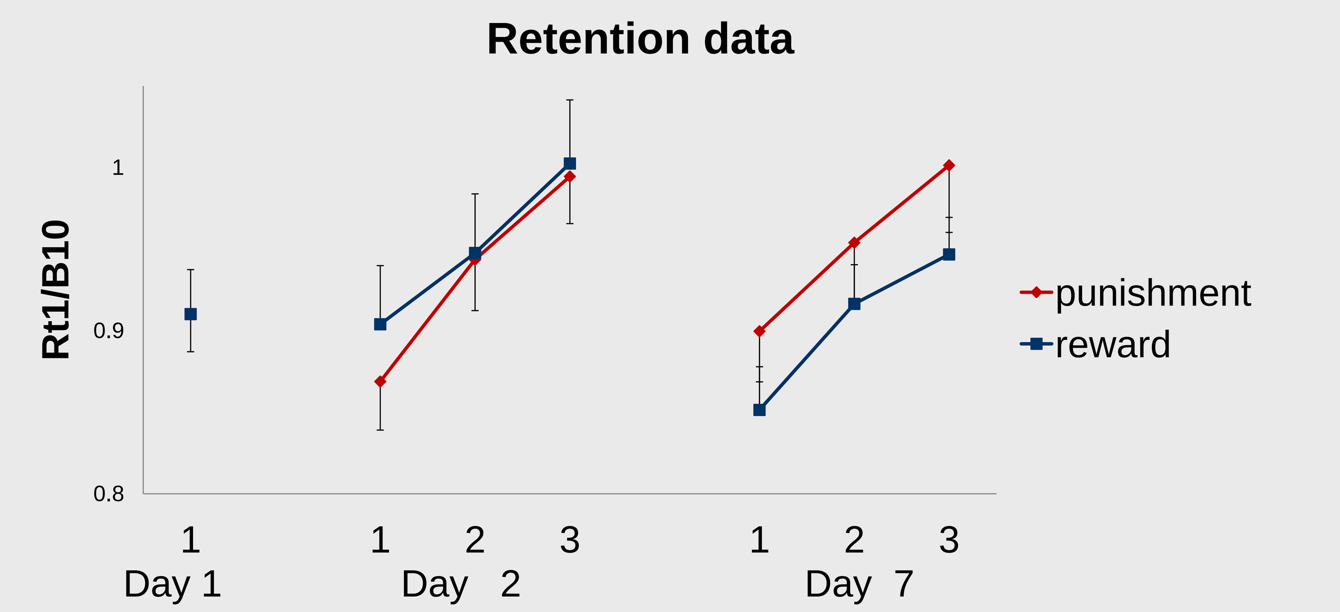
	REWARD	PUNISHMENT
Age	22.64 ± 2.10	22.71 ± 1.38
Male	8	5
Female	6	9
Left (Male)	2	1
Left (Female)	1	0
Earned money	26.66 ± 2.70	24.51 ± 2.24

RESULTS

BEHAVIORAL DATA

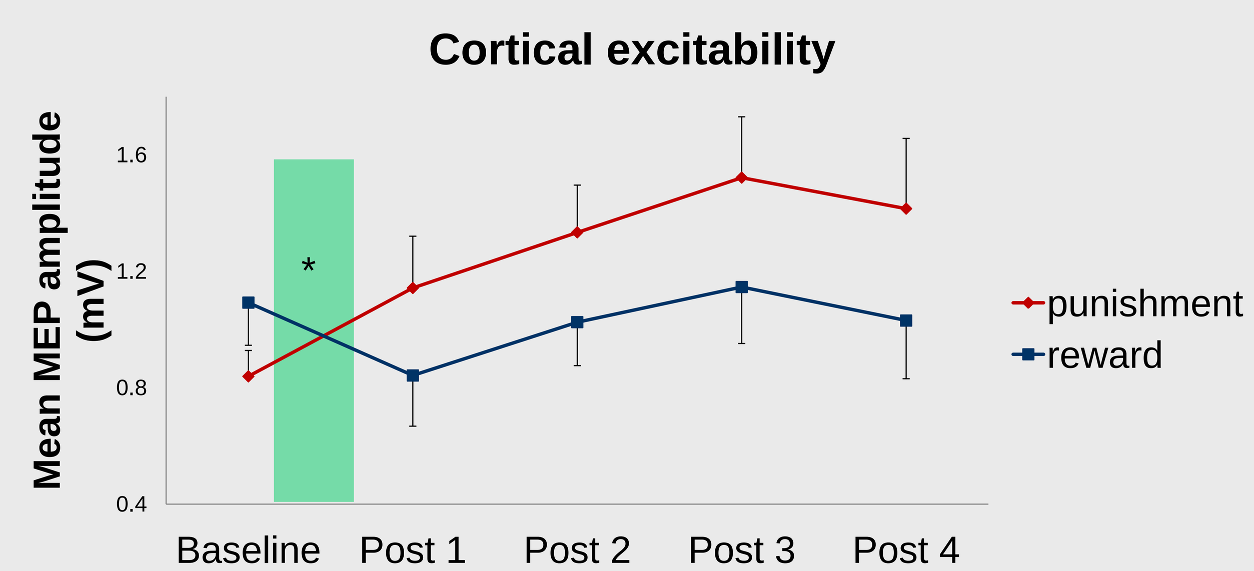


NO significant Group x Time interaction [F(9, 234)=1.2667, p=.2559]

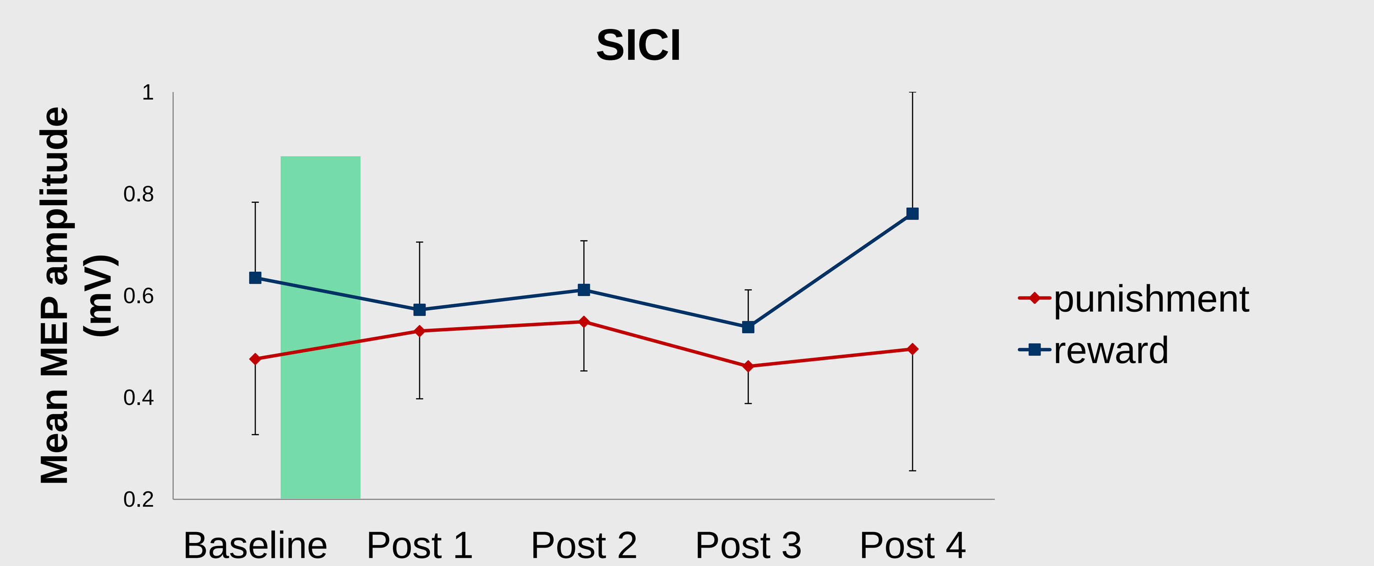


NO significant Group x Time interaction [F(6, 150)=.2563, p=.9560]

TMS DATA



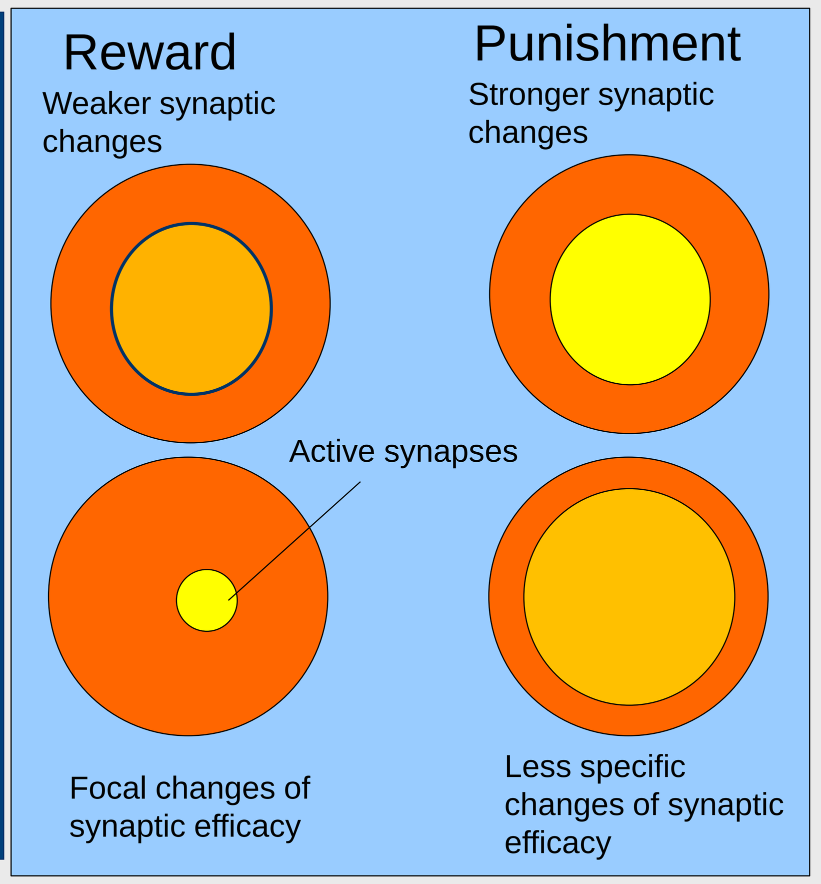
Significant Group x Time interaction [F(4, 104)=3.47, p<0.001]



NO significant Group x Time interaction [F(4, 104)=.607, p=.65803)

CONCLUSIONS

- **Reward and punishment group learned and retained the motor task equally well**
- **Learning-related dynamics of corticomotor excitability were significantly influenced by the reward scheme**
  - **The punished group exhibited an increase of corticomotor excitability immediately after training**
  - **In the rewarded group, on the other hand, corticomotor exitability decreased immediately after training**
- **No changes in intracortical inhibition (SICI) were revealed by reward or punishment**



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