University of Zurich UZH

Department of Psychiatry, Psychotherapy and Psychosomatics

Real-time fMRI Neurofeedback for Training Self Regulation of Reward Activation

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Supervisors:

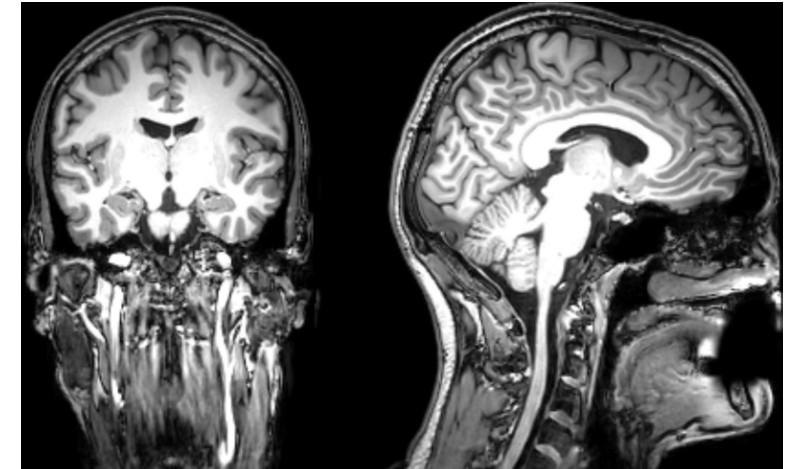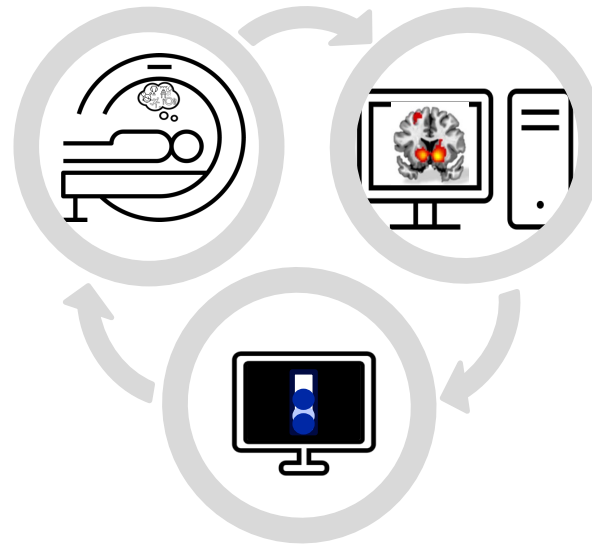Anna Trippel, M.Sc.

Ladina Gubser, M.Sc.

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Introduction

Introduction

- Pilot study with healthy participants of the bigger project "Co-Boost" at the PUK

- **Co-Boost:** rt-fMRI Neurofeedback in combination with Ketamine infusion for treatment of cocaine use disorder

- **My thesis:** Neurofeedback for training and quantifying individuals' ability to self-regulate reward activation with the aim of having greater control over substance use
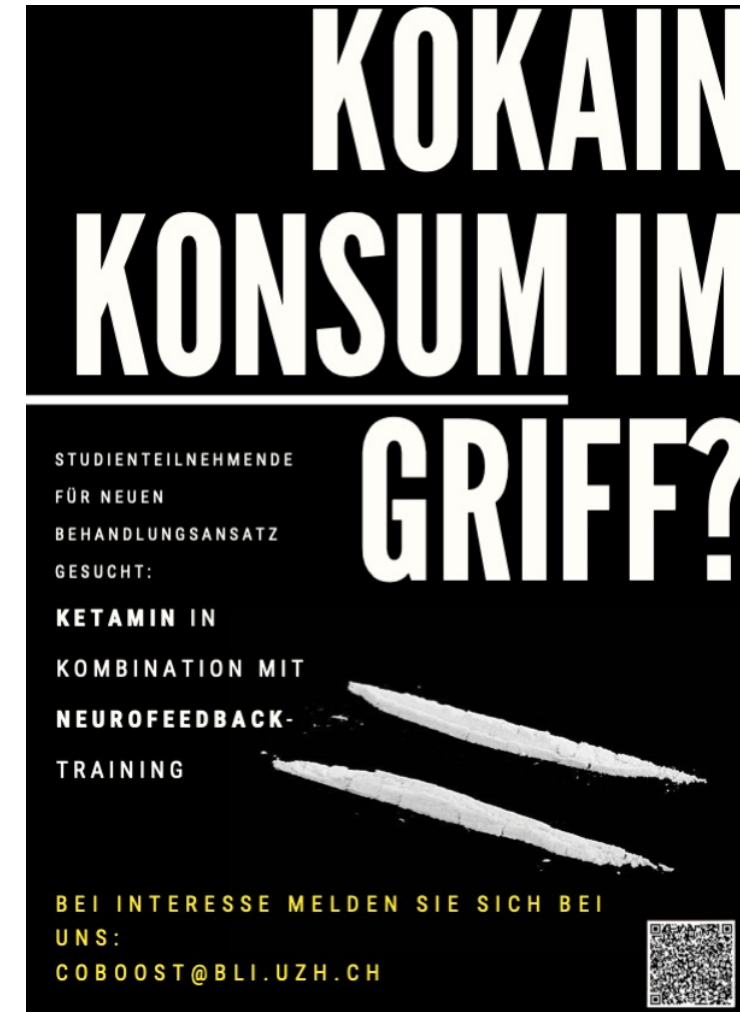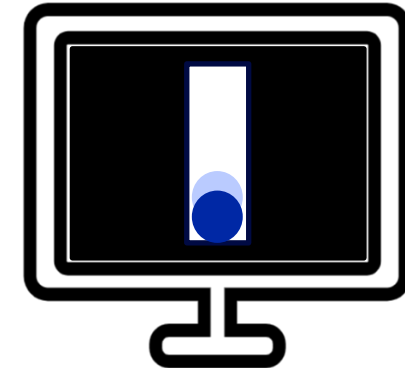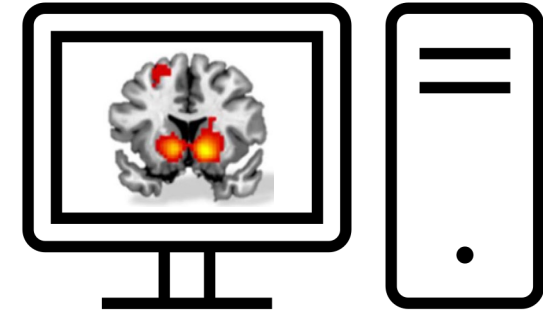
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Theoretical Background

Theoretical Background

– **Biofeedback:** explicit indicator of some physiological process, such as heartbeat or brain activation, so that an individual can attempt to regulate that activation or guide behaviour (Sitaram et al., 2017).

– **Neurofeedback:** type of biofeedback, in which neural activity is measured and a representation of this activity is presented to the participant in real time to facilitate self-regulation that underlie a specific behaviour or pathology (Sitaram et al., 2017).

Theoretical Background

– **Substance dependence ->** increased activity in reward regions like the ventral tegmental area and substantia nigra (VTA/SN) in response to drug-related cues

– & impaired sensitivity in these regions to non-drug rewards like external monetary or social reward cues (Kirschner et al., 2018).

– reward-related neural activation can be self-regulated using feedback of circumscribed brain activity measured with functional magnetic resonance imaging (fMRI) (Sulzer et al., 2013)
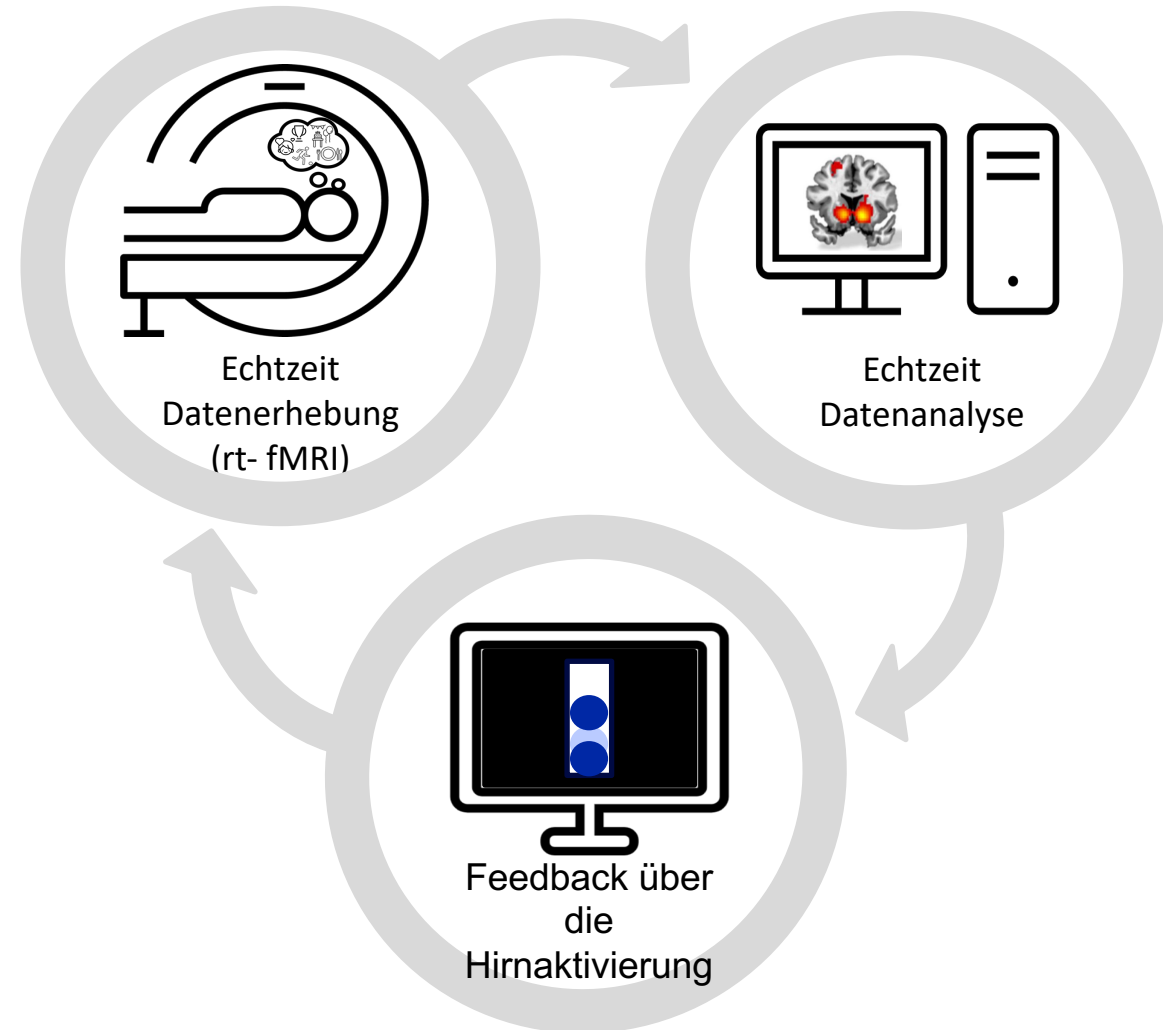
Echtzeit Datenerhebung (rt- fMRI)

Echtzeit Datenanalyse

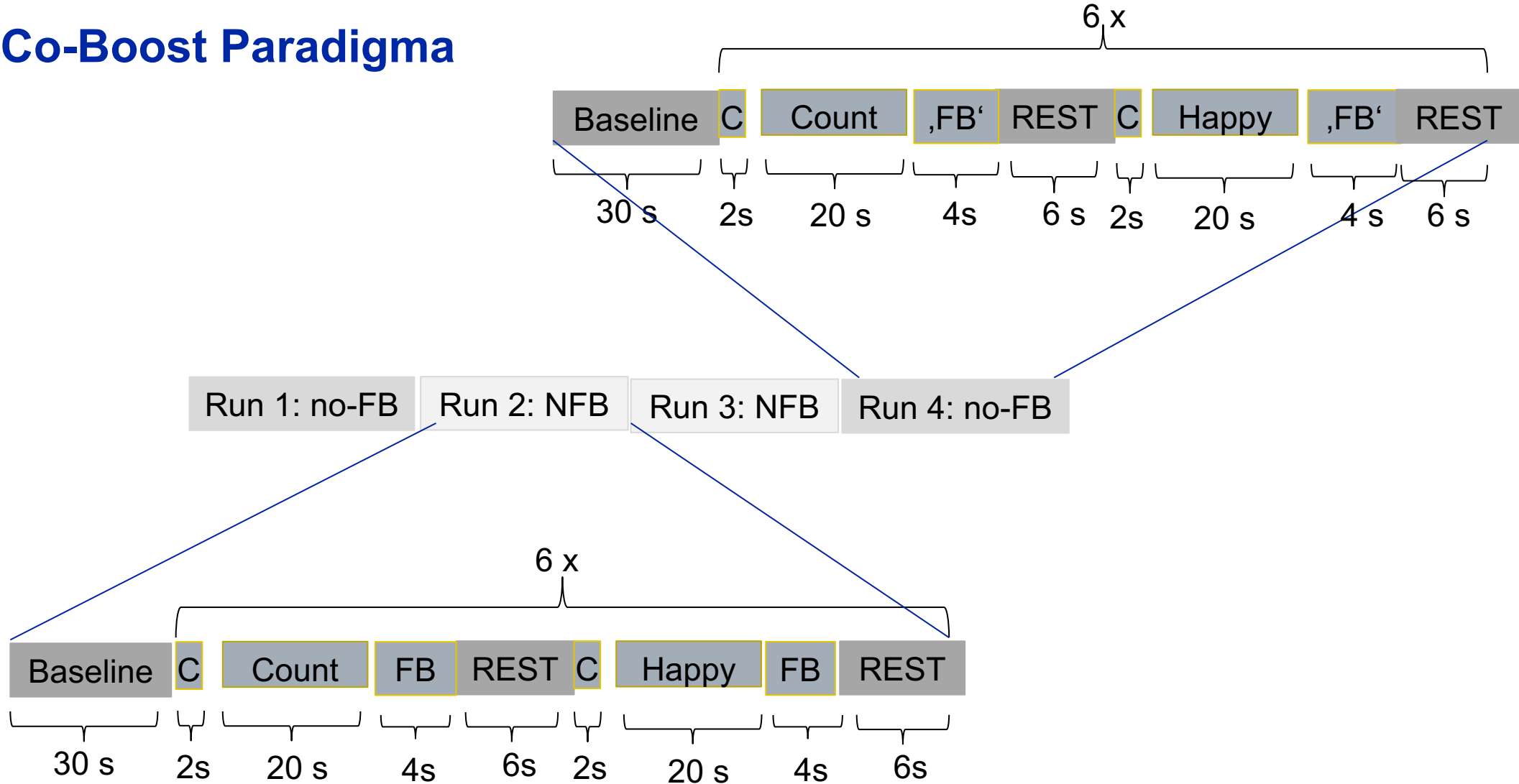Feedback über die Hirnaktivierung

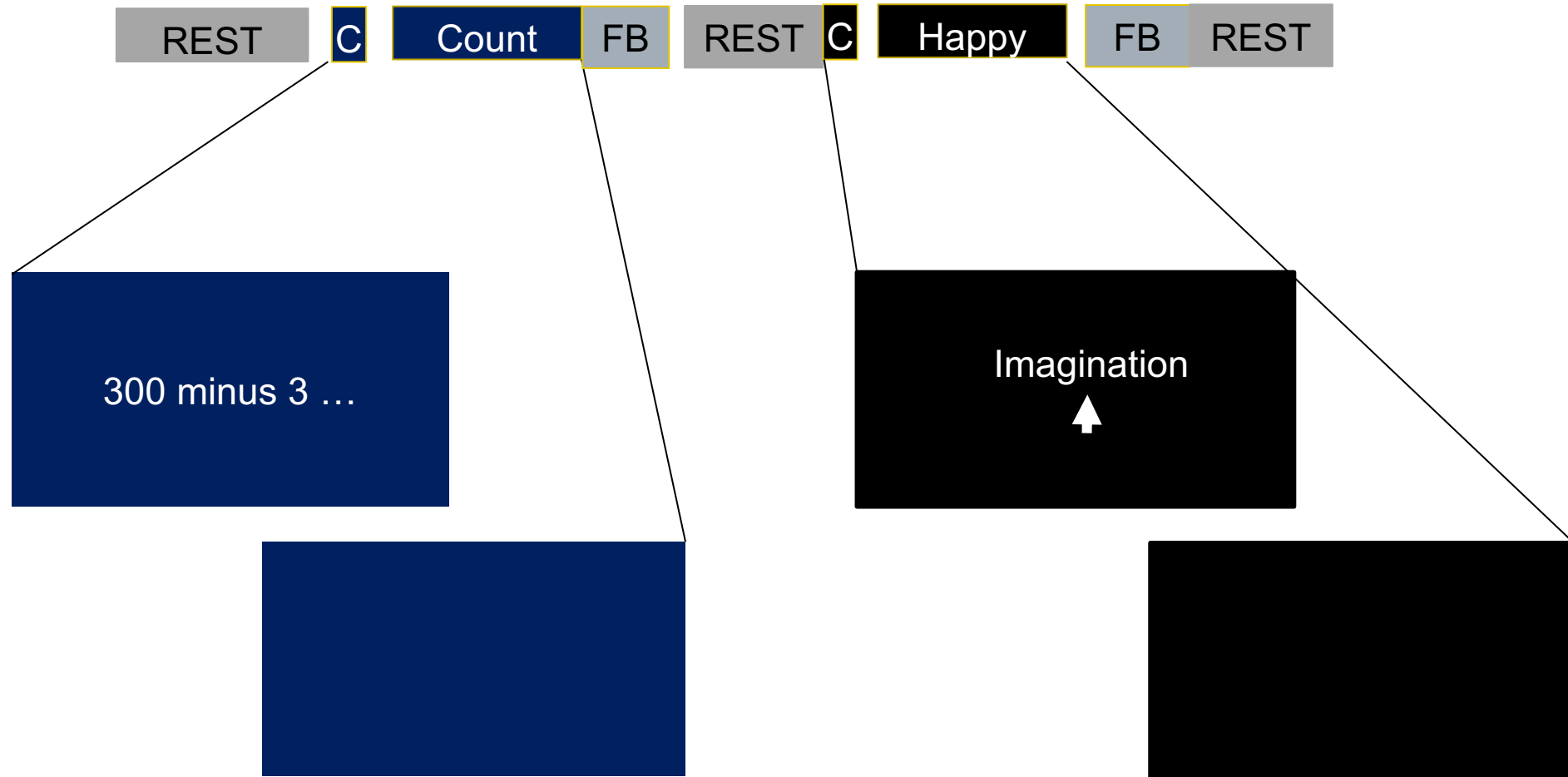# Experimental Design

Experimental Design

- One-time Neurofeedback Training session

- **Duration:** structural imaging (ca. 20 min.) and Neurofeedback Training (ca. 26 min.)

- N = 32

- Co-Boost Paradigma based on Kirschner et al., 2018

- In-between questionnaire, Prospective Imagery Task (PIT) & Neurofeedback Post Questionnaire

Co-Boost Paradigma

6 x

| Baseline | C | Count | ,FB' | REST | C | Happy | ,FB' | REST |

30 s · 2s · 20 s · 4s · 6 s · 2s · 20 s · 4 s · 6 s

| Run 1: no-FB | Run 2: NFB | Run 3: NFB | Run 4: no-FB |

6 x

| Baseline | C | Count | FB | REST | C | Happy | FB | REST |

30 s · 2s · 20 s · 4s · 6s · 2s · 20 s · 4s · 6s

Neurofeedback Training

Animated feedback presentation: Ball moves from minimal value level to median/AUC signal change activity of current „Happy"
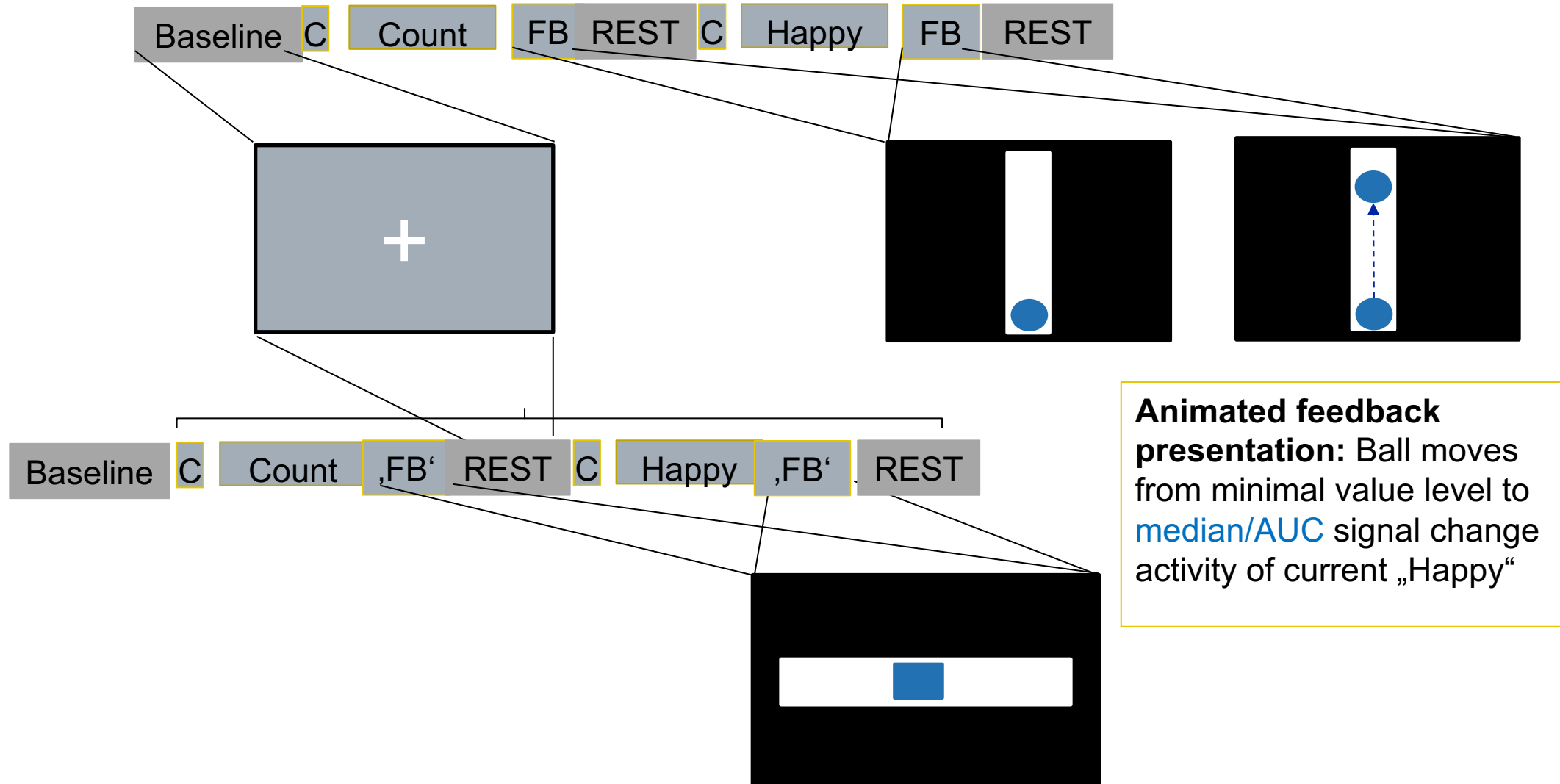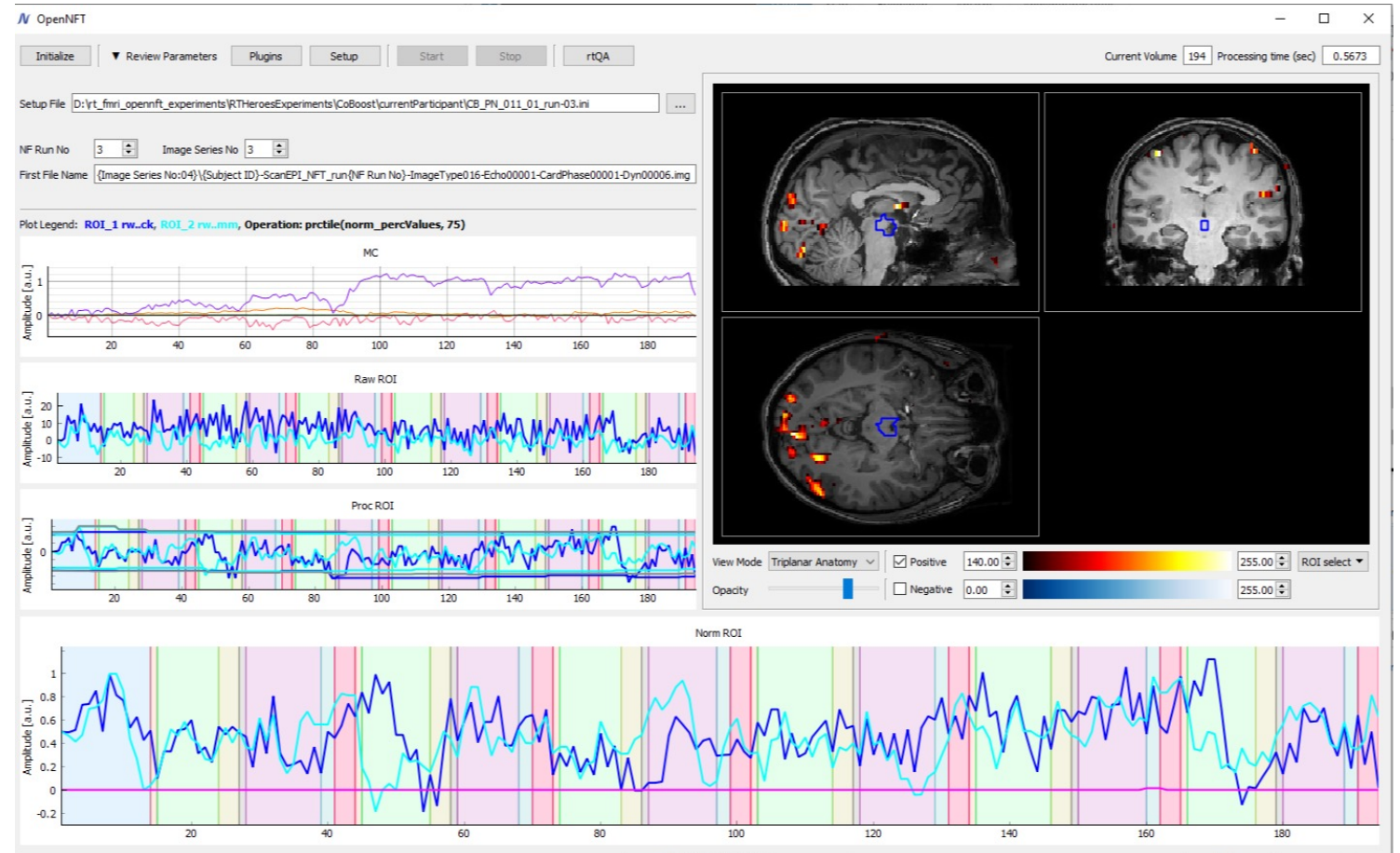
Neurofeedback Training

– VTA Mask from Alison Adcock (MacInnes et al., 2016)

– Last 18 seconds of the "Baseline" as comparison for calculation of the feedback

– Median & AUC for FB

– 4 & 5 Blocks

Prospective Imagery Task

– Based on McLeod and Byrne, 1996

– We use modified version of Kirschner et al. 2018

– After the Neurofeedback Training

Im Folgenden geben wir Ihnen acht verschiedene Kategorien, welche Lebensbereiche mit potentiell positiven Erfahrungen und Erinnerungen widerspiegeln. Wir bitten Sie jetzt um Ihre persönliche Einschätzung, welche Kategorien für Sie am relevantesten sind.

Bewerten Sie dafür die untenstehenden Kategorien und wählen Sie Ihre Top-3 Kategorien.

* must provide value

☐ Kontakt mit Menschen
☐ Essen
☐ Sportliche Aktivitäten
☐ Gutes Erlebnis im Beruf
☐ Gutes Erlebnis in der Freizeit
☐ Romantisches oder sexuelles Ereignis/Fantasie
☐ Begegnung mit Tieren
☐ Situationen in der Natur
☐ Andere

Nun bitten wir Sie, eine kleine Übung zu machen: Versuchen Sie, zu jeder Ihrer drei Lieblingskategorien ein möglichst reales Bild vor ihrem geistigen Auge zu formen. Nehmen Sie sich dafür je ca. 20 Sekunden Zeit.

In-Between and Post Neurofeedback Questionnaire

In-Between Questionnaire:

– Mood

– Concentration

– Categories of the strategies used

– Subjective assesment of self-regulation success

– Some additional questions in the **Post Neurofeedback Questionnaire**

Wie gut konnten Sie sich beim Kopfrechnen auf das "runter zählen" konzentrieren?

Bitte geben Sie Ihre Antwort hier ein:

* must provide value

gar nicht   sehr stark

Change the slider above to set a response

Sind Ihre Gedanken während dem Kopfrechnen abgeschweift?

* must provide value

○ Ja
○ Nein

Wenn Sie das Experiment nochmal durchführen könnten, glauben Sie, dass Sie sich noch weiter verbessern könnten?

Bitte geben Sie Ihre Antwort hier ein:

* must provide value

gar nicht   auf jeden Fall

Change the slider above to set a response

Research Questions

Research Questions

- Were the participants able to successfully self-regulate reward activation with reward imagery?

- Correlation of *self-regulation success* and *PIT-score*

Literaturverzeichnis

Literaturverzeichnis

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