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Wanting and Liking within the Human Ventral Striatum: a "high-resolution" fMRI study

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Neuroscience Masters' Day

INTRODUCTION

- The aim of the study is to disentangle **salient motivation** (how much the person invests energy to obtain a reward) and **hedonic pleasure** (how much a reward is liked)[1].
- **Animal studies[2] have succeed to dissociate the two components** by manipulating the tonic dopamine release in the NAcc (nucleus accubens), however the existence of such a dissociation is **still debated in humans**.
- This **neuroimaging study** aims to investigate the **dissociation of reward processing in humans** using a psychological manipulation rather than a brain manipulation.

METHOD

Subjects:

- **Twenty-four** right-handed undergraduate students from Geneva (18–36 y/o) who like chocolate.

Stimuli:

- Three different **complex geometrical figures** where used as visual stimuli.
- Twelve **odor stimuli**[3].

Task: Analog of a human **Pavlovian-Instrumental Transfer (PIT)** paradigm[4].

(a) Learning to **squeeze a hand dynamo-meter** to trigger the release of a rewarding chocolate odor.

(b) Exposition to repeated pairings of the **positive conditioned stimulus (CS+)** with the rewarding chocolate odor and the **negative conditioned stimulus (CS-)** with the odorless air. When the CS+ or CS- was displayed, a target appeared in the center and **participants had to press a key that triggered odor release**. The baseline was displayed without any target, and no odor was released.

(c) Under extinction, the conditions were displayed in random order. The participants **could squeeze the handgrip if they wished to do so**.

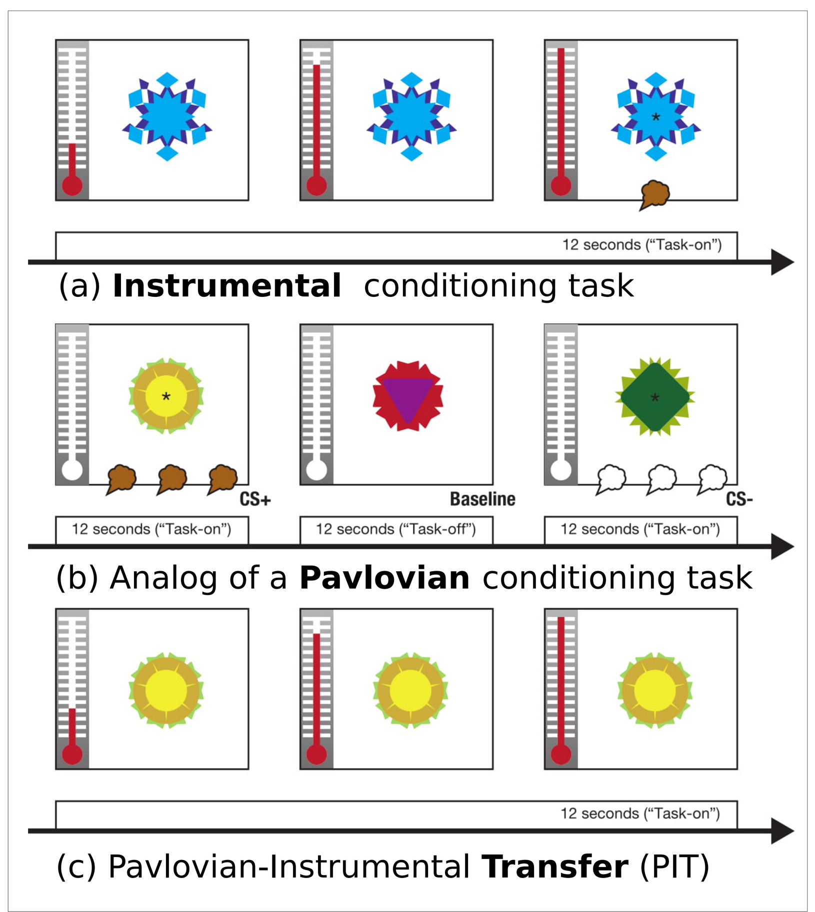

Fig. 1. Example of a PIT CS+ trial[5].

Procedure: The experiment took place over **two separate days** in the Brain Behavior Lab in Geneva.

- The first day we checked our manipulations by making our participants complete the **two first phases (a) and (b)** and evaluate the intensity and liking of each of the 12 odor stimuli.
- The second day happened **in the scanner** where participants had to **accomplish the complete PIT task** while also **re-evaluating the odor stimuli**.

Behavioral Data Analysis: We used the lme4[6] package on R to perform a **linear mixed effect analysis** with planned contrasts.

- We looked at the **relationship between the behavioral PIT and the salient motivation** of the participant. Our **dependent variable was the number of grips** and our fixed effects was the experimental conditions (CS-, CS+ and Baseline). As random effects, we had intercepts for subjects and trials, as well as by-subject random slopes.
- We also **checked that our manipulation of the behavioral index of hedonic pleasure was valid**. Our **dependent variable was the reported pleasantness** of the stimuli and our fixed effects were the odors (Control, Neutral and Chocolate). We also added random effects intervals and slopes.

BEHAVIORAL RESULTS

- The **CS+** affected the number of grips ($\chi2$ (1) = 11.192, **$p < .001$**), raising it by 4.52 ±0.4 SEM compared to the average of the other conditions (n=24).
- The **chocolate** affected the perceived liking ($\chi2$ (1) = 9.658, **$p < .001$**), raising it by 16.96 ±0.6 SEM comparing to the average of the other conditions (n=24).

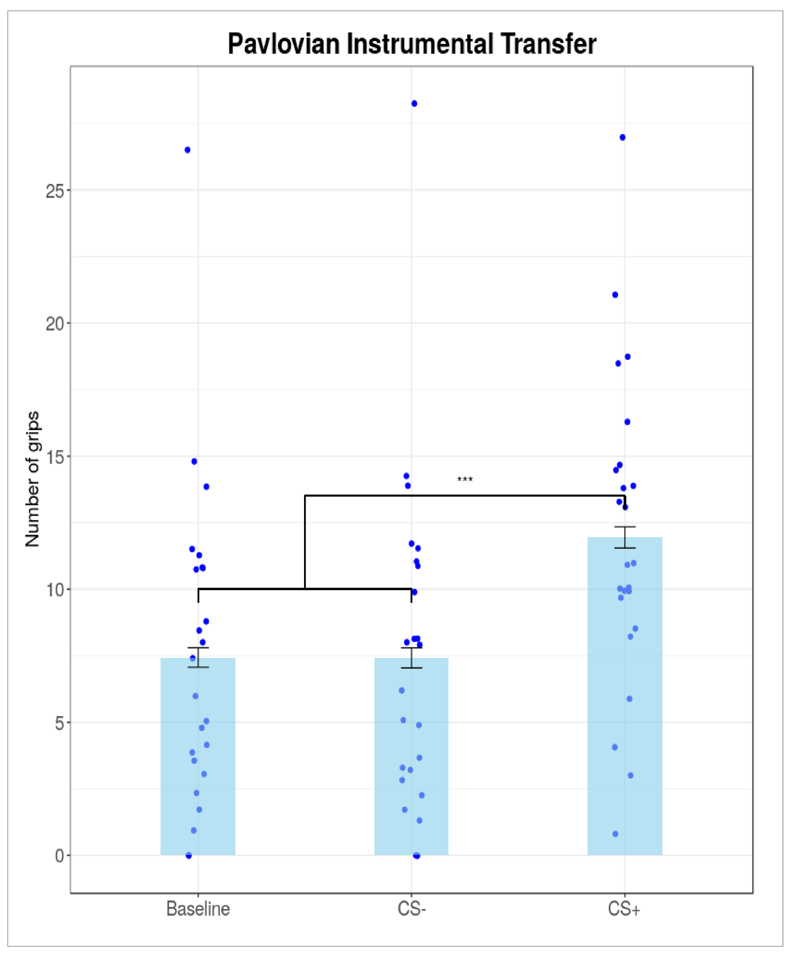

Fig. 2. Means of the numbers of grips during the PIT per condition with individual data. Error bars indicate mean ±1 SEM.

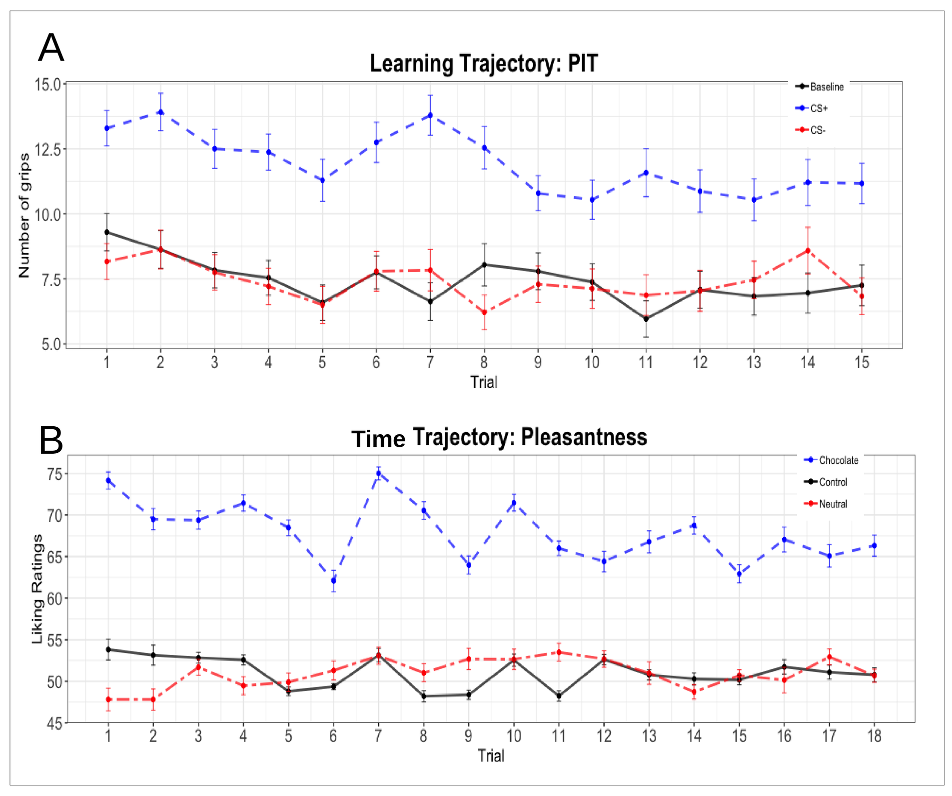

Fig 3. Learning and time trajectories for both tasks.

(A) Average number of grips per condition over time. Error bars indicate mean ±0.5 SEM.

(B) Average ratings of the pleasantness of the stimuli per condition over time. Error bars indicate mean ±0.5 SEM.

PREDICTIONS AND PLANNED ANALYSIS

- The **caudal** and **medial** parts of the **NAcc (core)** will correlate more with the **Pavlovian Instrumental Transfer.**
- The **rostral** and **lateral** parts of the **NAcc (shell)** will correlate more with the **behavioral index of hedonic pleasure**.

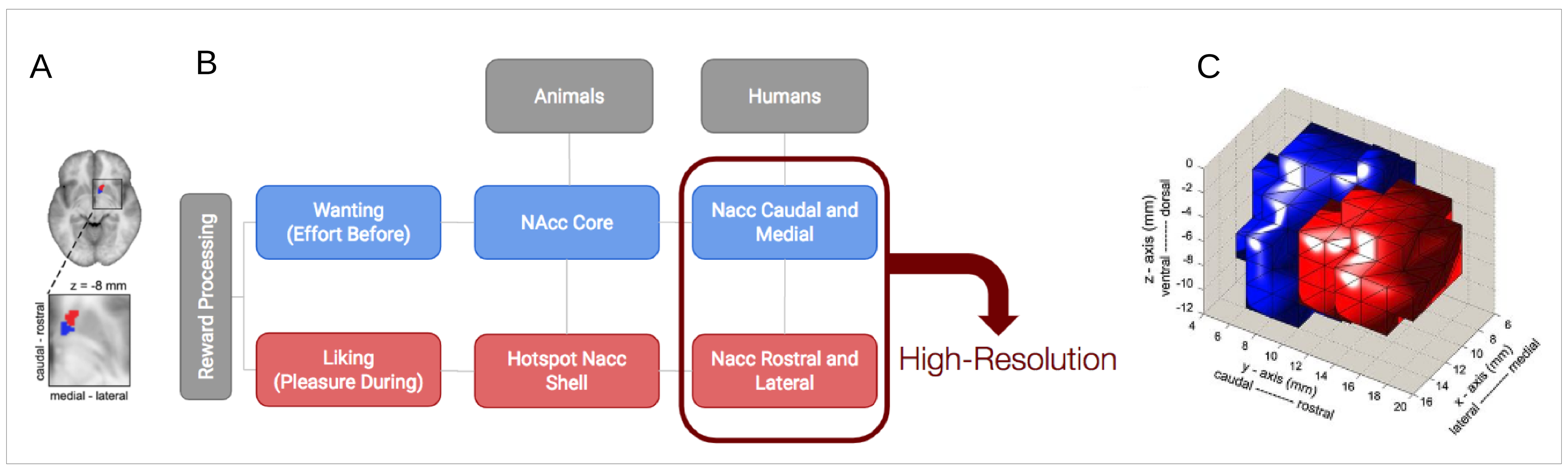

Fig. 4. (A) DTI clustering of the right NAcc into two subdivision adapted from Baliki et al. (2013)[7]. (B) Diagram representation of our hypothesis following animal studies (C) Three-dimensional rendering of NAcc's core and shell[7].

- We are currently working on the analysis of our neuroimaging data.

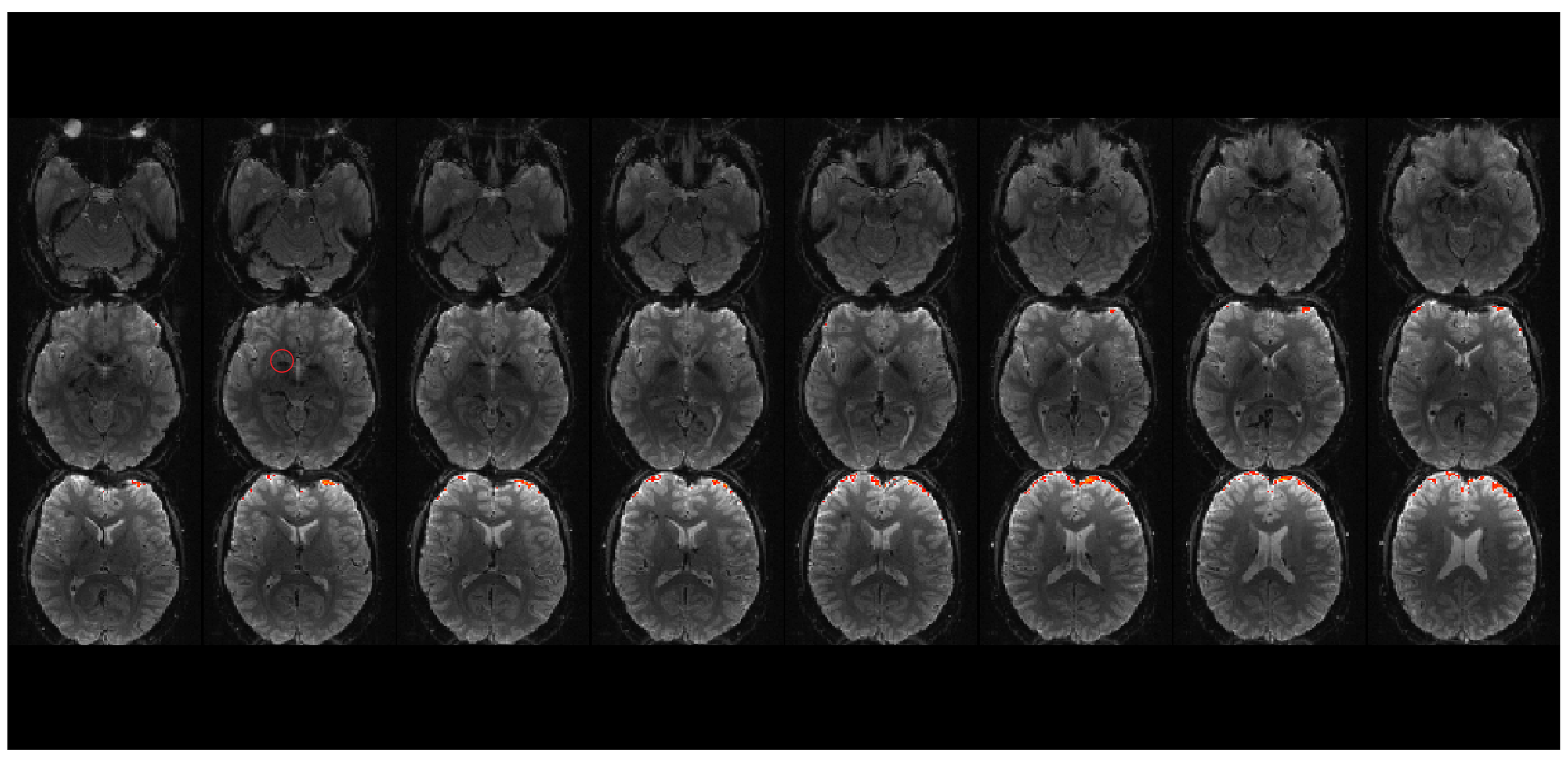

Fig. 5. A sample of our imaging data (T1w axial view, FSLeyes). 26 Partial EPI (echo-planar imaging), TR = 2400, TE = 41, 1.8 voxel isometric.

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