Exploring the Impact of Food Choice on Brain Responses to Sweet Drinks using fMRI

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Working hypothesis

- Individuals attribute a higher value to rewards they personally choose, compared to rewards that are imposed upon them

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Aim

- Can the enhancement of reward resulting from choice during drinking experiences be corroborated by distributed neural representations across the brain ?
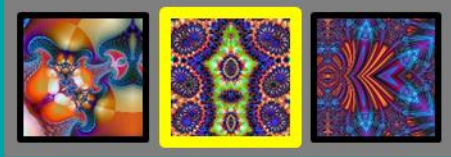
Subjects and methods

- Brain functional MRI
  - BOLD contrast
- 36 healthy volunteers
  - 21 females / 15 males
- For each subject, identification of three fruit-flavored drinks
  - ~/Equal preferences from a selection of commercially available options
- Liquid food stimuli
  - Drinks presented while in the MRI scanner using a gustometer

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Trial outline

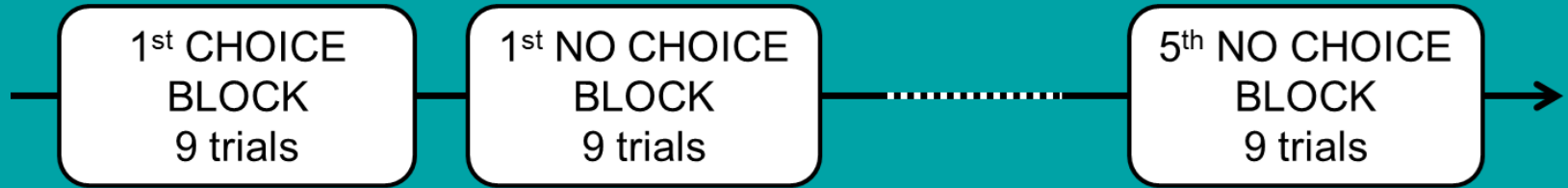**Choice**

OR

No choice

Did you like this drink?

SWALLOW

| 6s | 5s | 12s | 3s |

Cue

Drink → Features

Subjective value rating (SVR)

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Paradigm

1st CHOICE BLOCK 9 trials	1st NO CHOICE BLOCK 9 trials	...	5th NO CHOICE BLOCK 9 trials

Volunteer chooses:

x2

x4

x3

randomized order

- 45 trials in choice condition
- 45 trials in no choice condition

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Multivariate Pattern Analysis

- Able to decode some perceptual or higher cognitive content from brain activity

- Brain activity = features measured in a spheric ROI

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Behavior

- ANOVA results
  SVR assigned to the drinks in choice condition were **significantly higher** than in no choice one $F_{(1)} = 5.6918$, $p = 0.01709$
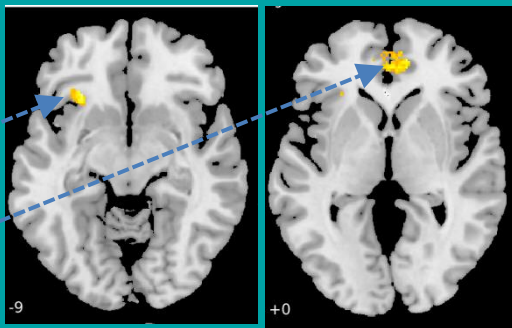
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Question 1

- **Can the MRI signal obtained during the drink period be classified in two classes defined by the subsequent SVRs ?**

- 90 SVRs split in 2 classes = High / Low likings

Results 1

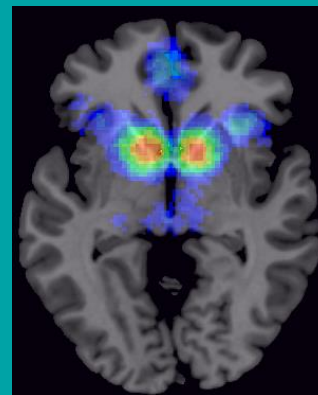- **Fine scale**
Ventral striatum
Inferior frontal gyrus
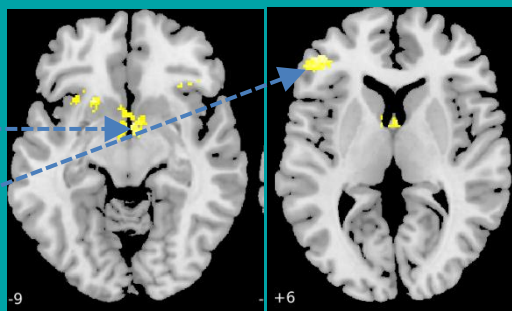
- **Mid. scale**
Anterior insula
VmPFC

Group-level / p = 0.0001 k>80 / pFWE < 0.05 cluster level

- **Reward domain**

Bartra et al. doi:10.1016/j.neuroimage.2013.02.063

- Regions which encode the two classes of SVR belong to the **reward domain**
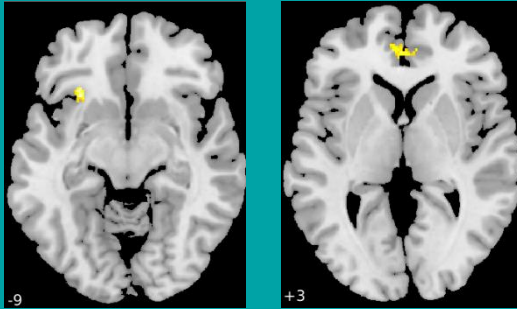
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Question 2

- **Are the SVR decoding maps influenced by the choice condition within the identified reward domain?**

- Same SVR-based decoding as for Q1 but in choice and no choice conditions separately

Results 2

No choice

Choice

Ant. Ins.
VmPFC

-9   +3

Group-level / p = 0.0001 k>80 / pFWE < 0.05 cluster level

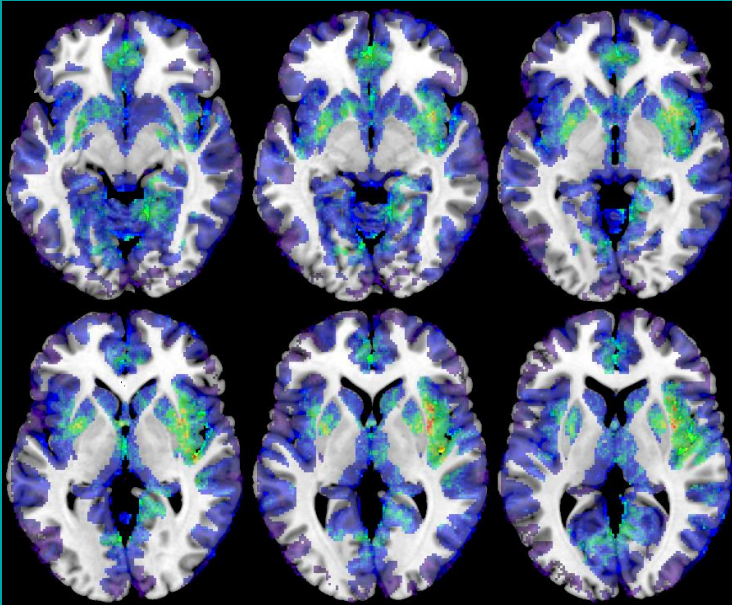- **No cluster**

- Choice conditions shape the decoding of SVR

SD(no choice) > SD(choice)
(*) p = 0.023

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Question 3

- **Can the MRI signal obtained during the drink period be classified in two classes corresponding to the choice/no choice conditions ?**

- Design

    Detection of the preferred drink / selected n times (< 45)
    n drink features in choice and no choice conditions

Results 3

- Accuracy > 0 in
  - vmPFC
 - Ventral striatum
  - Insula (R)
  - Putamen (L/R)

- Group-level / t-map [15,50]

- Ubiquitary effect of choice
  - Strong effect size in the reward domain

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Conclusions

- Several brain fMRI evidences support the (positive) effect of choice on the reward elicited by the drinks

- SVR collected (soon) after drinking are related to the reward

- MVPA
  - Flexible approach for interpreting fMRI data

- The information to decode should be categorical
  - How to classified the SVR ?

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Multivariate Pattern Analysis
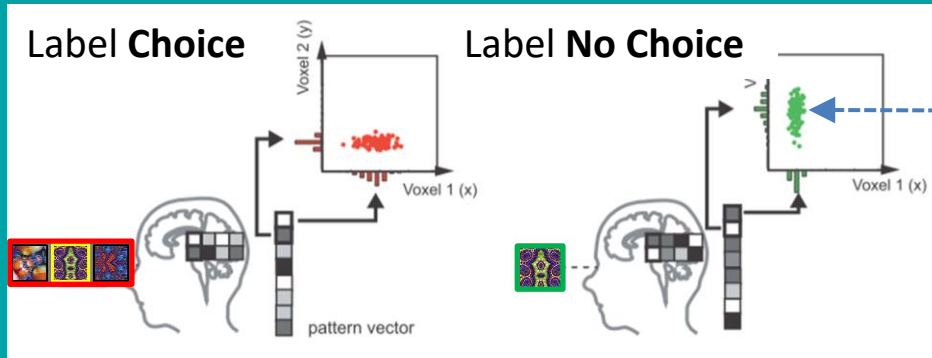
One point per repetition

Haynes et al. doi:10.1016/j.neuron.2015.05.025

H0 : Number of hits is due to chance

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