CAN GAMIFIED INTERVENTIONS TARGETING ALTERED COGNITIVE PROCESSES IN OBESITY CHANGE FOOD VALUATION AND CONSUMPTION?

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& HUGO NAJBERG

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MY RESEARCH IN FEW WORDS

FOOD & HUMAN
BEHAVIOR LAB

BODY MASS INDEX (BMI) DEFINITION

BMI = weight (kg) / height $(m)^2$

Under 18.5 kg/m^2 : underweight

Between 18.5 and 24.9 kg/m^2 : healthy weight

Between 25 and 29.9 kg/m^2 : overweight

Equal or superior to 30 kg/m^2 : obesity

WHAT DO WE KNOW ABOUT OBESITY ON THE PSYCHOLOGICAL LEVEL?

Obesity is associated with an alteration in some

- **cognitive** (e.g., memory)
- **affective** (e.g., emotional regulation)

functions

VICIOUS CIRCLE?

Excessive food intake

Neuroinflammation

Obesity & cognitive dysfunctions

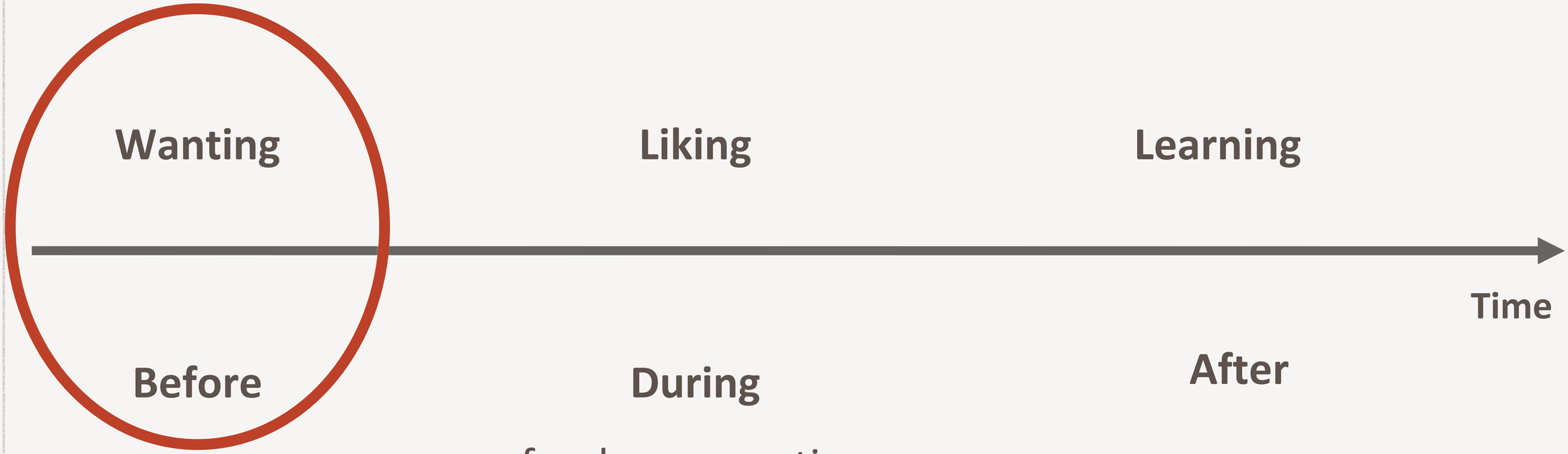
Increased appetitive responses to food cues

Cognitive dysfunctions (e.g., in memory)

Davidson et al. (2014). *Neurobiology of Learning and Memory.*

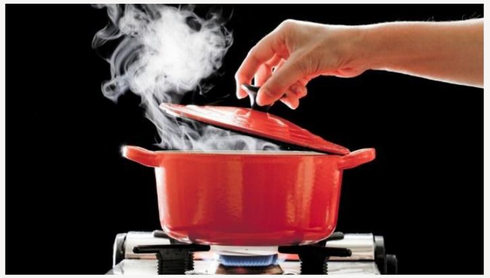
WHAT IS FOOD REWARD?

DIFFERENT SUB-COMPONENTS OF REWARD



Kringelbach (2015).
Flavour.

WANTING



Motivation to obtain a reward, triggered by a stimulus previously associated with a reward

Berridge & Robinson (2003). *Trends in Neurosciences.*

IN HUMANS, DIFFERENT MEASURES OF WANTING

Handgrip

COMPARER WANTING IN PARTICIPANTS WITH DIFFERENT BMI

vs.

Eccellenza grant from the SNSF

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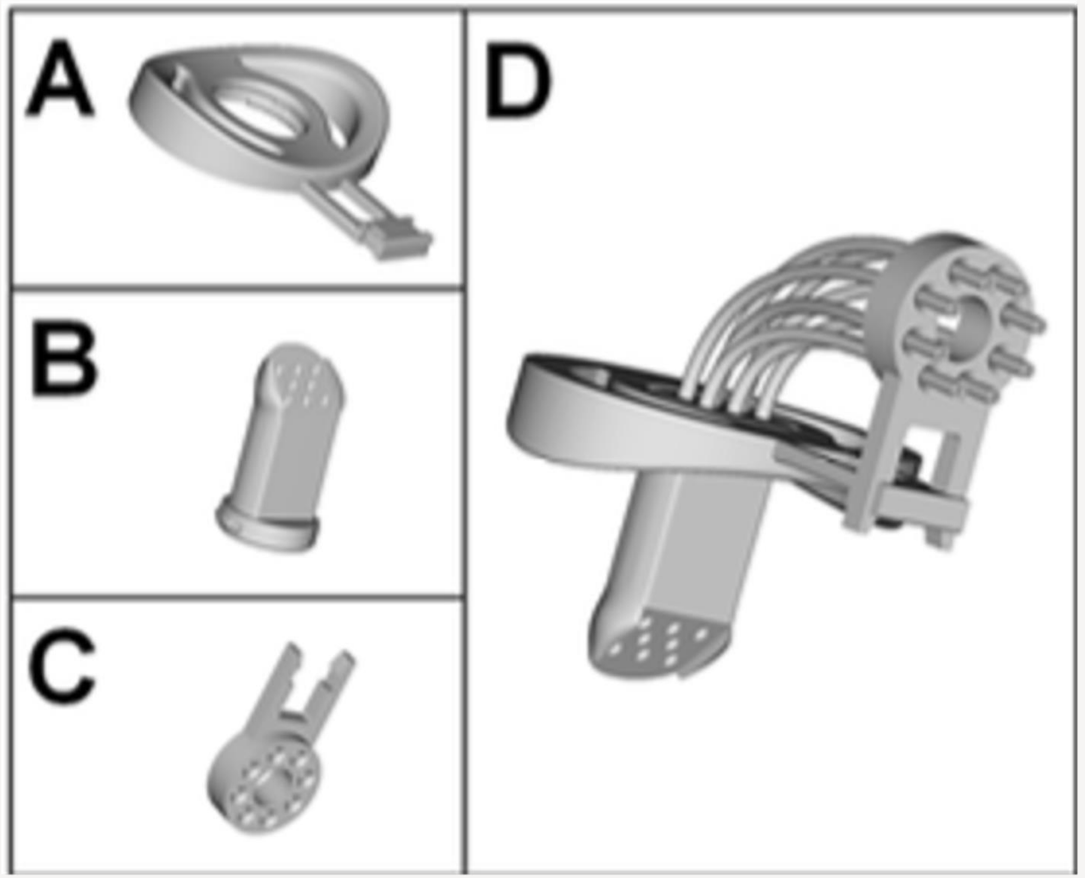
COMPARER WANTING IN PARTICIPANTS WITH DIFFERENT BMI



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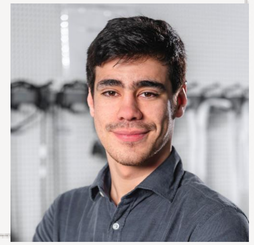
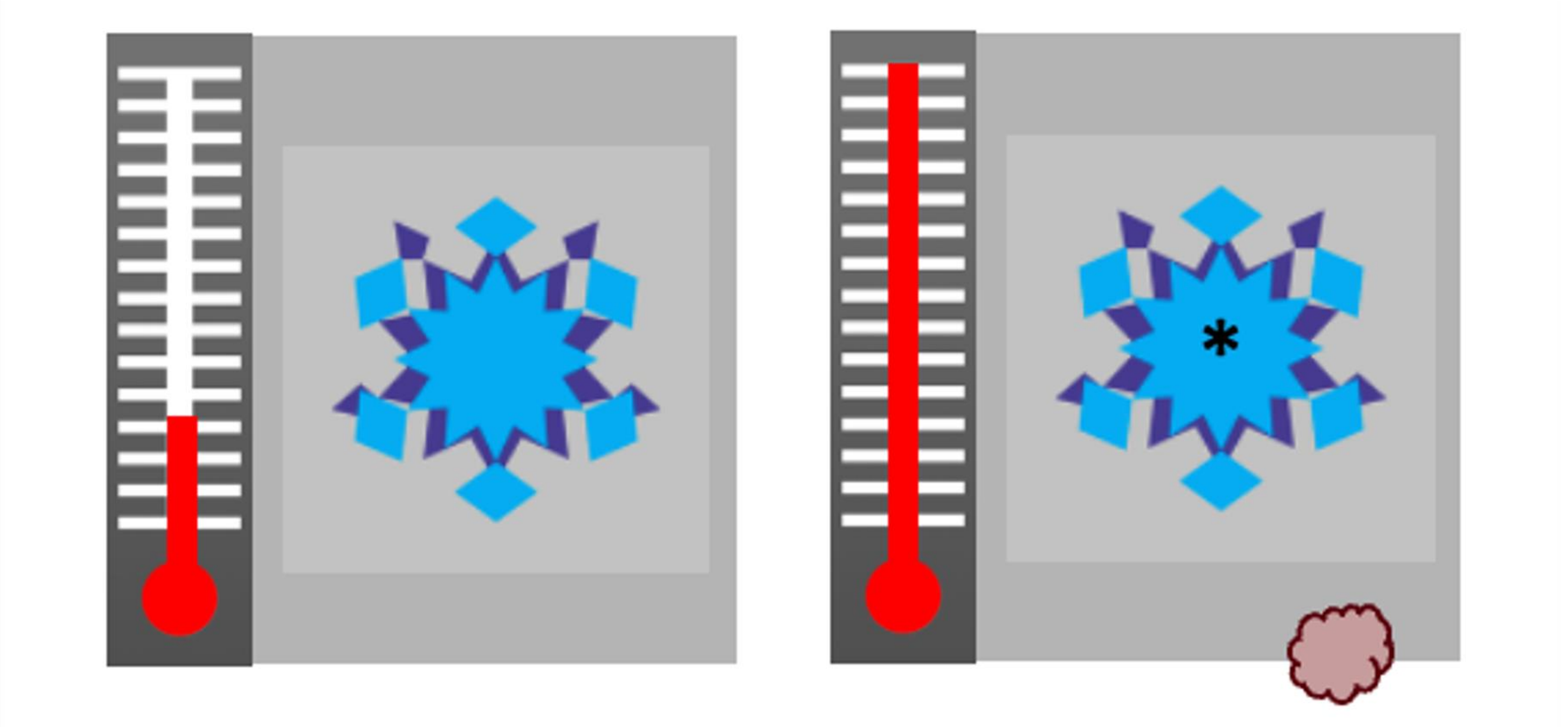
Muñoz-Tord*, Coppin* et al. (2021). *Eneuro.*



WANTING TASK
PAVLOVIAN-INSTRUMENTAL TRANSFER (PIT) TEST

Part 1: Instrumental learning



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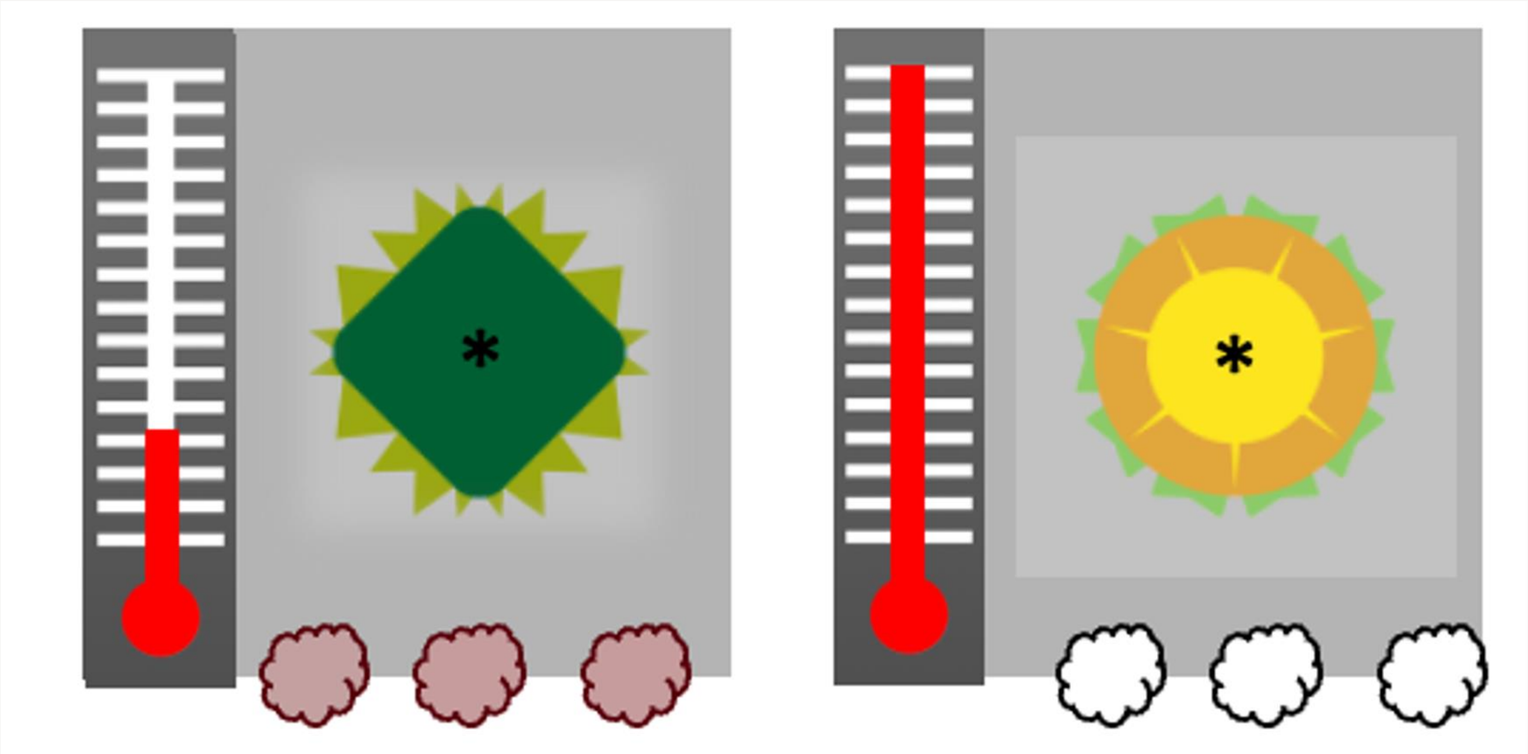
Coppin et al. (in preparation).

WANTING TASK
PAVLOVIAN-INSTRUMENTAL TRANSFER (PIT) TEST

Part 2: Pavlovian learning



CS+ CS-

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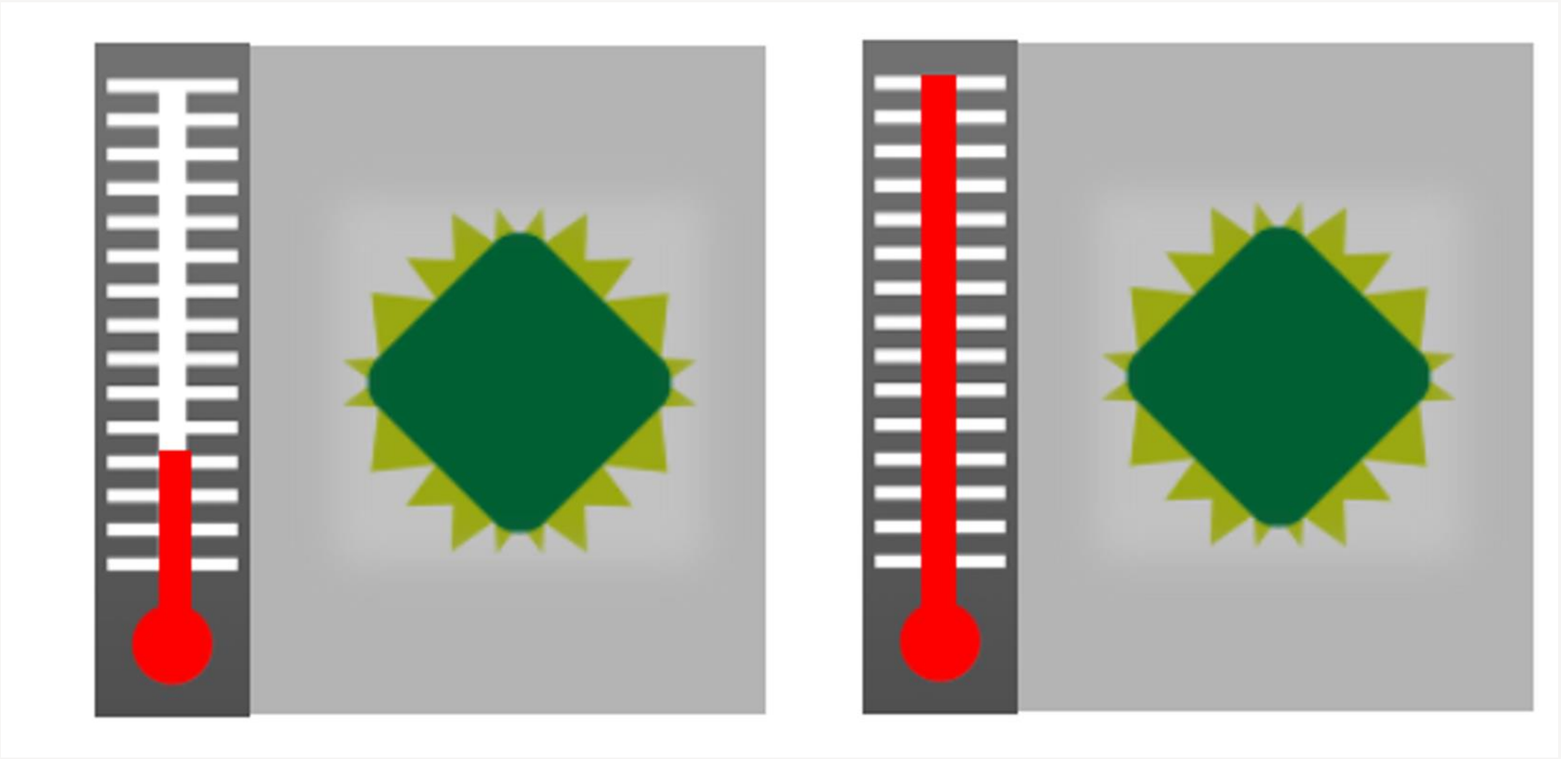
Coppin et al. (in preparation).

WANTING TASK
PAVLOVIAN-INSTRUMENTAL TRANSFER (PIT) TEST

Part 3: Pavlovian instrumental transfer



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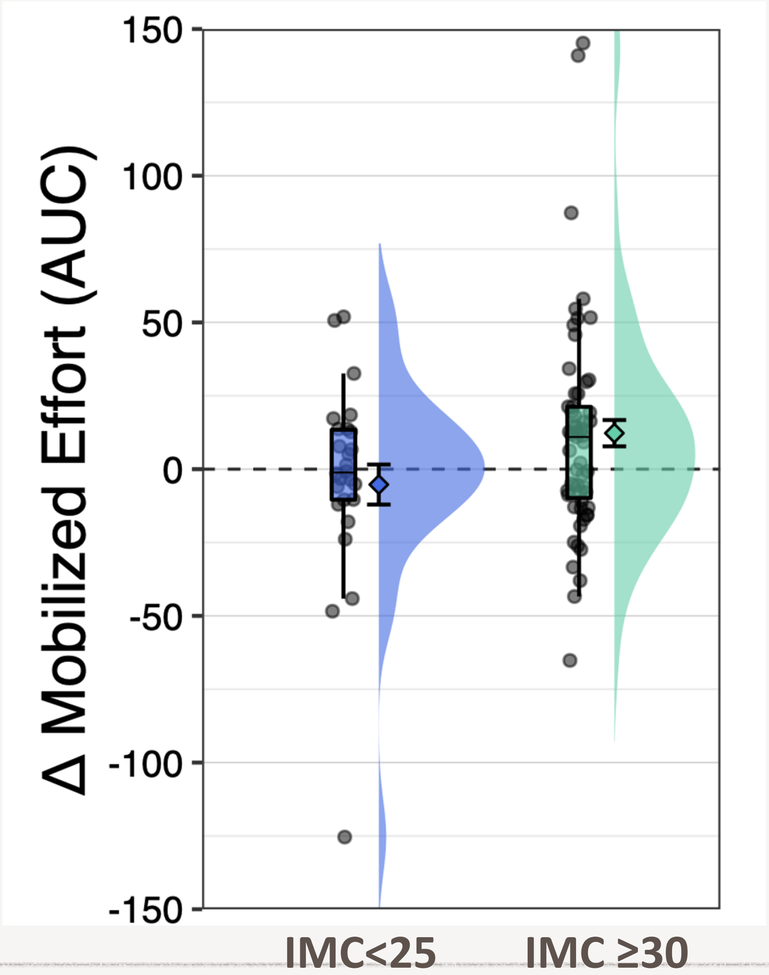
Coppin et al. (in preparation).

INCREASED WANTING IN INDIVIDUALS WITH BMI≥ 30



CS*Group: p = .031, BF = 3.73

CS+ > CS-:

IMC<25: p = .77

IMC ≥30: p = .003

CS*Hunger: p < .001

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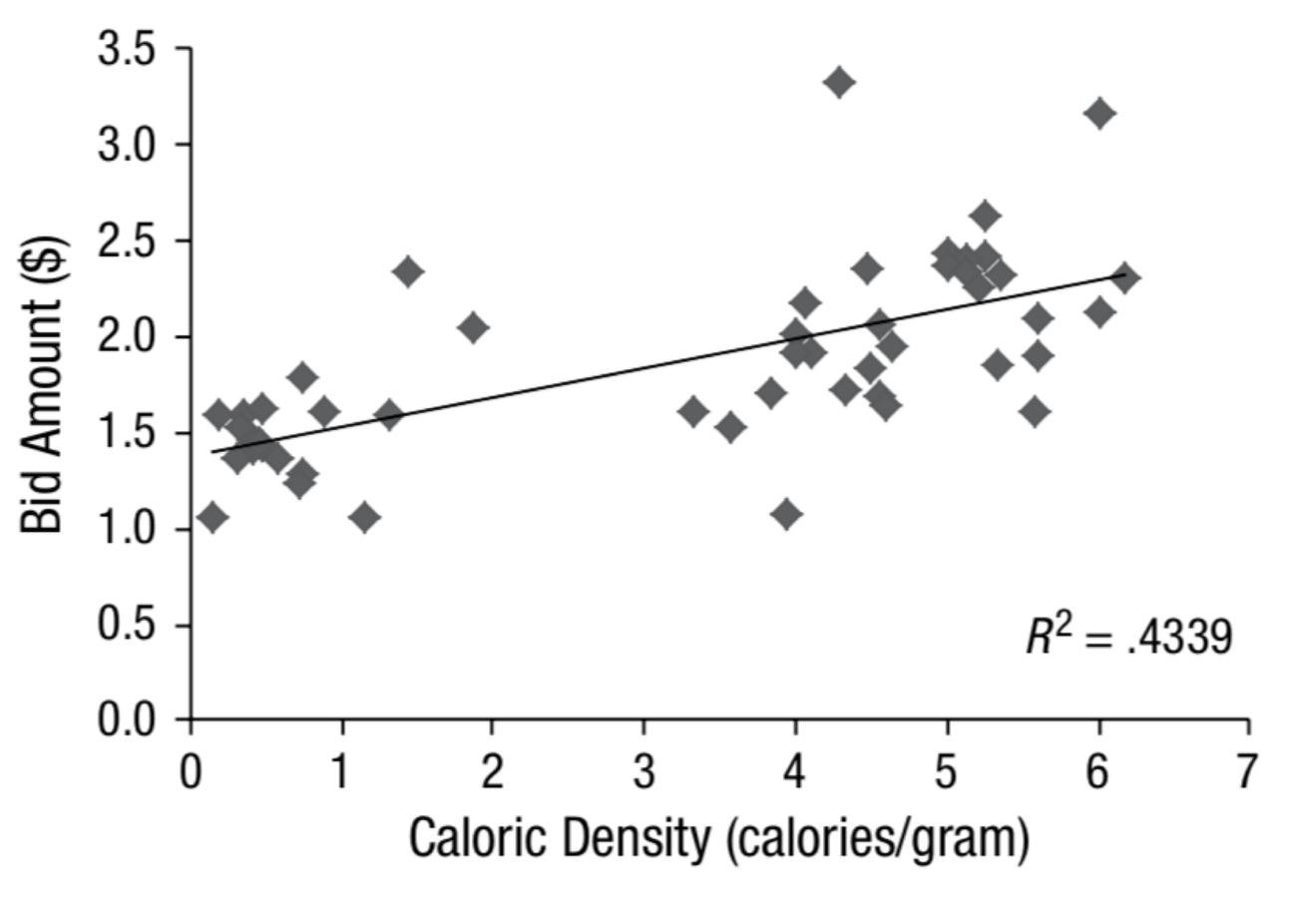
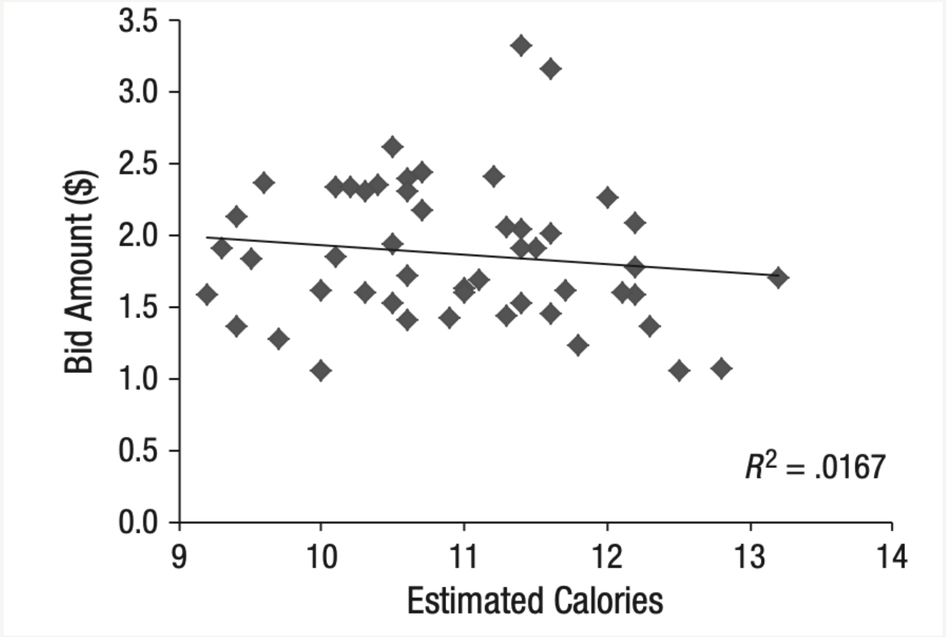
Coppin et al. (in preparation).

IN HUMANS, DIFFERENT MEASURES OF WANTING

Willingness to pay = how much money are you willing to pay for…

WILLINGNESS TO PAY DEPENDS ON CALORIE DENSITY





Tang et al. (2014). *Psychological Science.*

CURRENT FOOD ENVIRONMENT: FULL OF FOOD ITEMS WITH A UNIQUE COMBINATION OF FAT AND CARBOHYDRATES

ARE WE WILLING TO PAY MORE FOR FOOD ITEMS RICH IN CARBOHYDRATES AND FAT?

YALE Psychiatry

THE JOHN B. PIERCE LABORATORY
Physiology and Health in the Modern Environment

Max Planck Institute
for Metabolism Research

Funding : Post-doctoral fellows from the SNSF and Marie Curie

Fonds national suisse

MARIE CURIE ACTIONS

ARE WE WILLING TO PAY MORE FOR FOOD ITEMS RICH IN CARBOHYDRATES AND FAT?

Collaboration with Prof. DiFeliceantonio

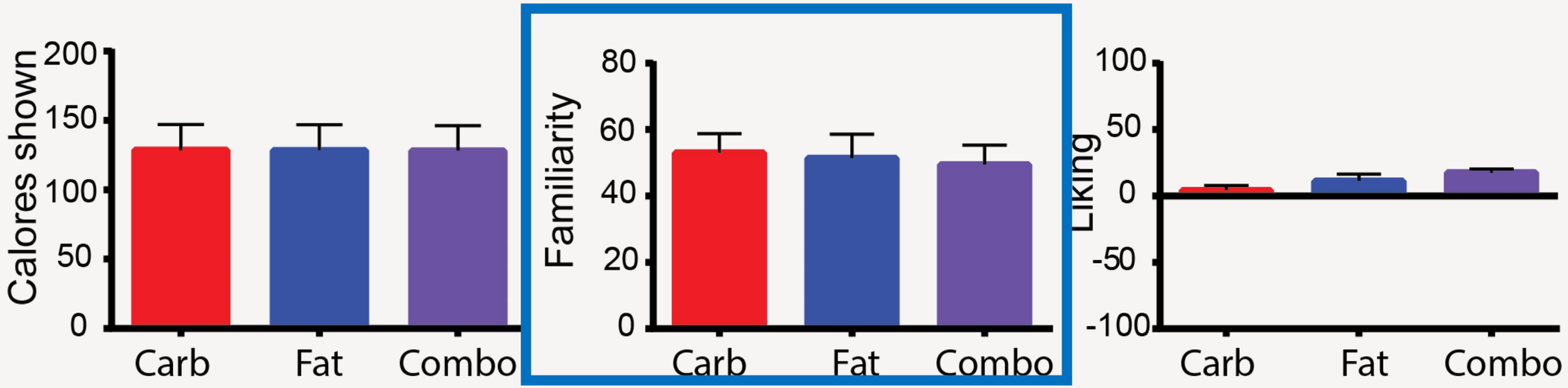
DiFeliceantonio*, A., Coppin*, G., Rigoux, L., Edwin-Thanarajah, S., Dagher, A., Tittgemeyer, M., & Small, D. M. (2018). Evidence for distinct and interacting signals for fat and carbohydrate reinforcement in humans. *Cell Metabolism, 28,* 33-44.

STIMULI CREATION

Carbohydrates

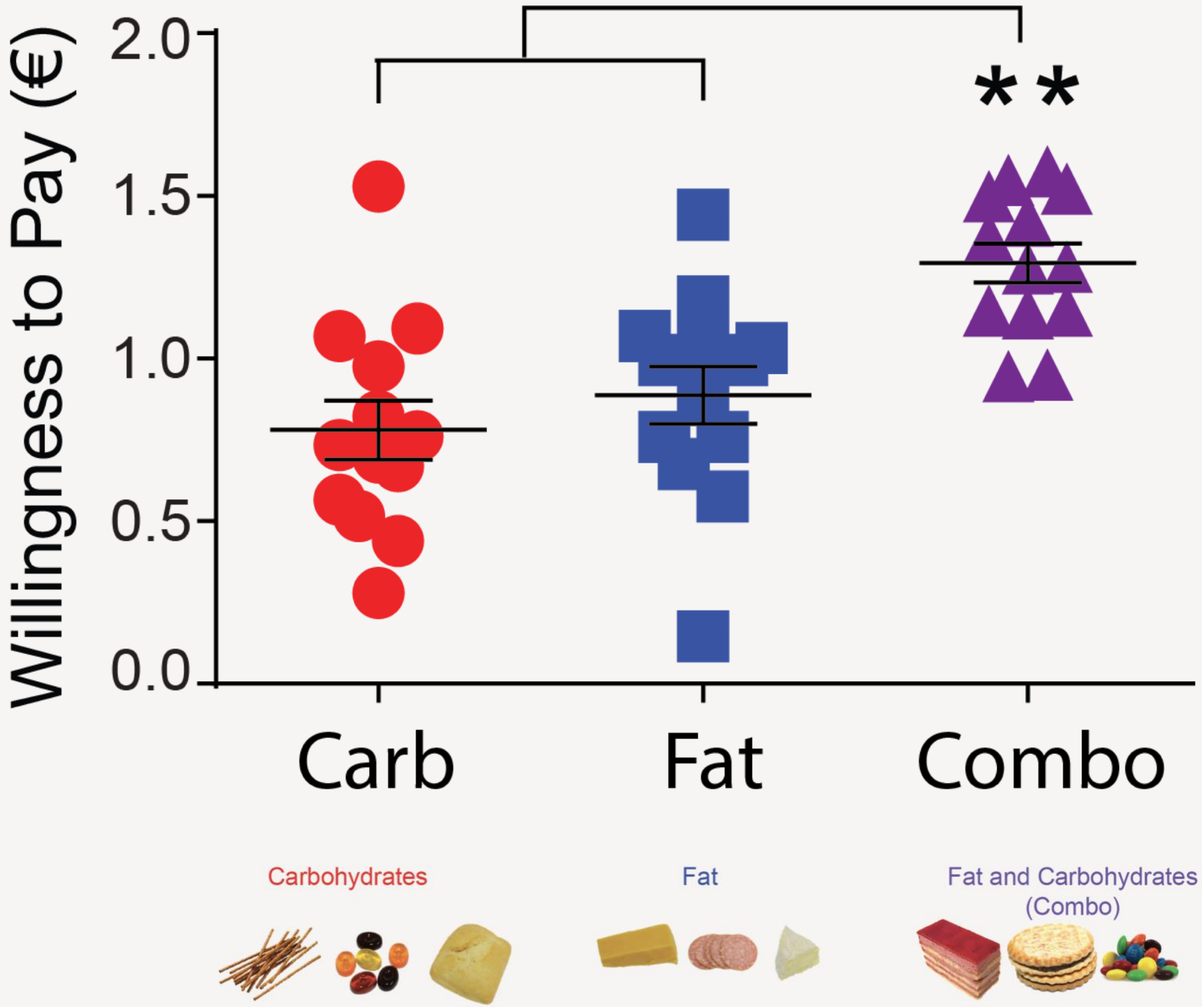
Fat

Fat and Carbohydrates (Combo)



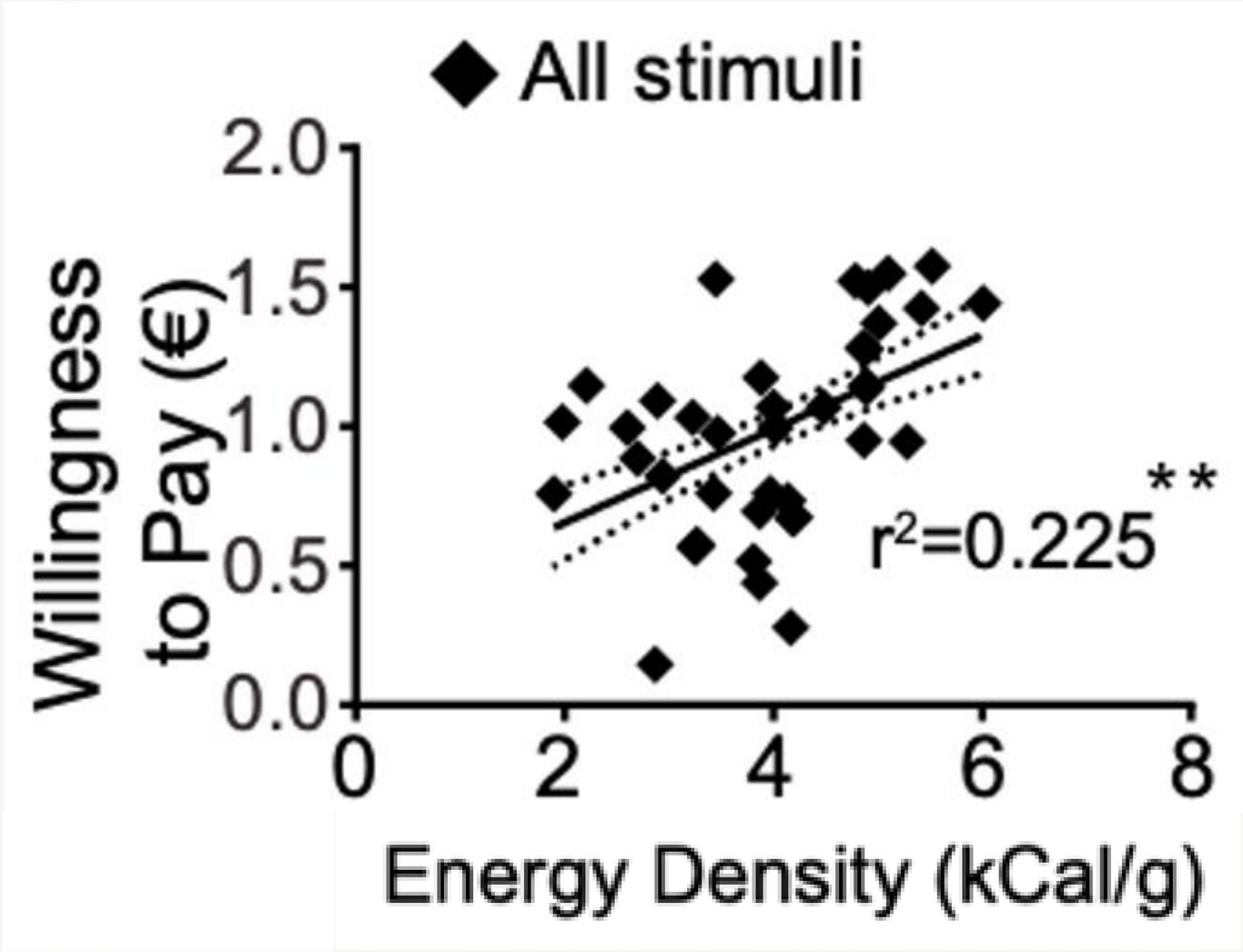
DiFeliceantonio*, Coppin* (2018). *Cell Metabolism.*

THE SOURCE OF CALORIES MATTERS



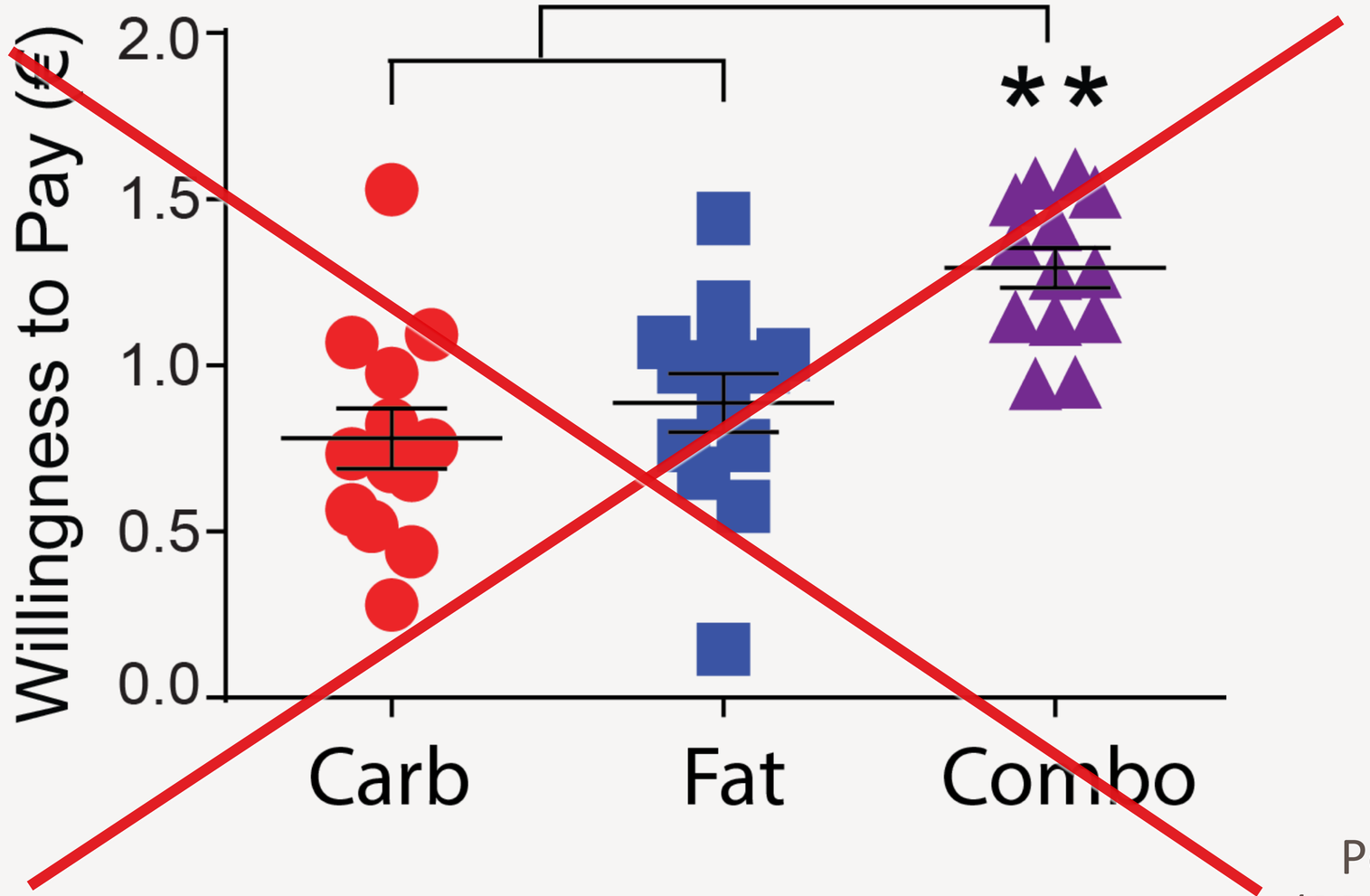
DiFeliceantonio*, Coppin* (2018). *Cell Metabolism.*

REPLICATION - *WILLINGNESS TO PAY* DEPENDS OF ENERGY DENSITY



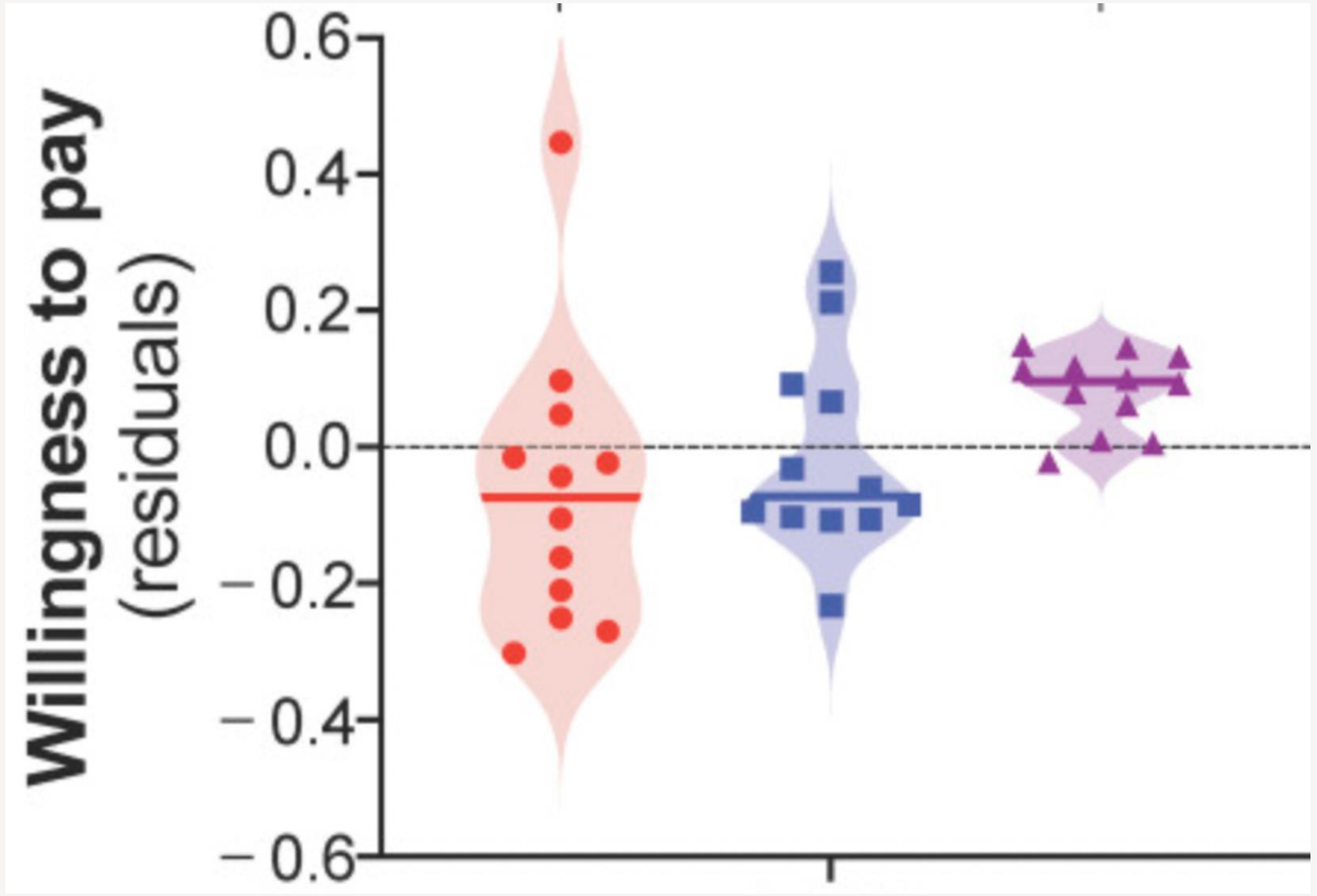
DiFeliceantonio*, Coppin* (2018). *Cell Metabolism.*

NOT FOR INDIVIDUALS WITH A BMI > 25



Perszyk et al. (2021). *Nutrients.*

REPLICATION FOR INDIVIDUALS WITH A BMI < 25



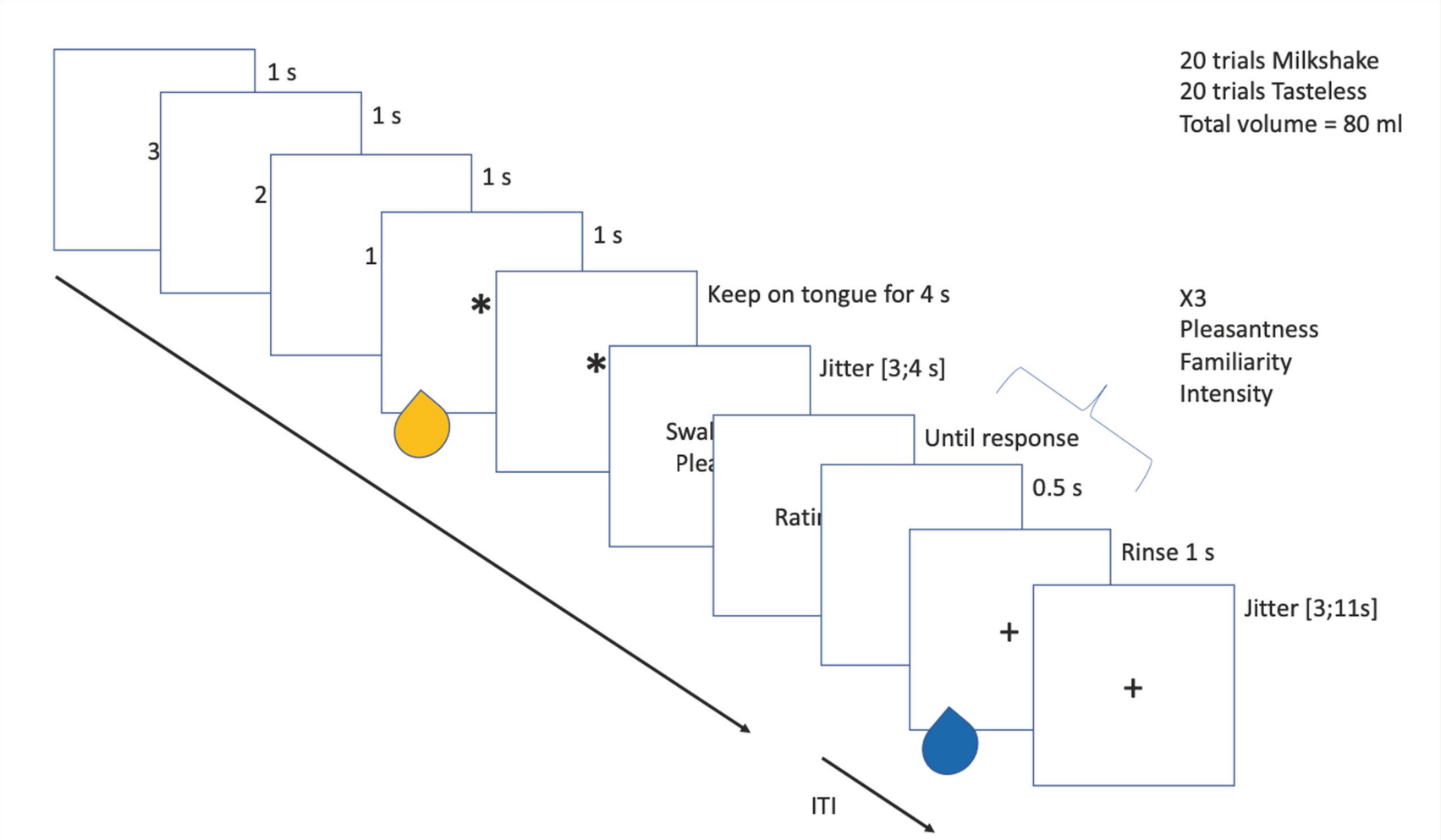
Perszyk et al. (2021). *Nutrients.*

LIKING

Hedonic experience triggered by the consumption of a reward

Berridge & Robinson (2003). *Trends in Neurosciences.*

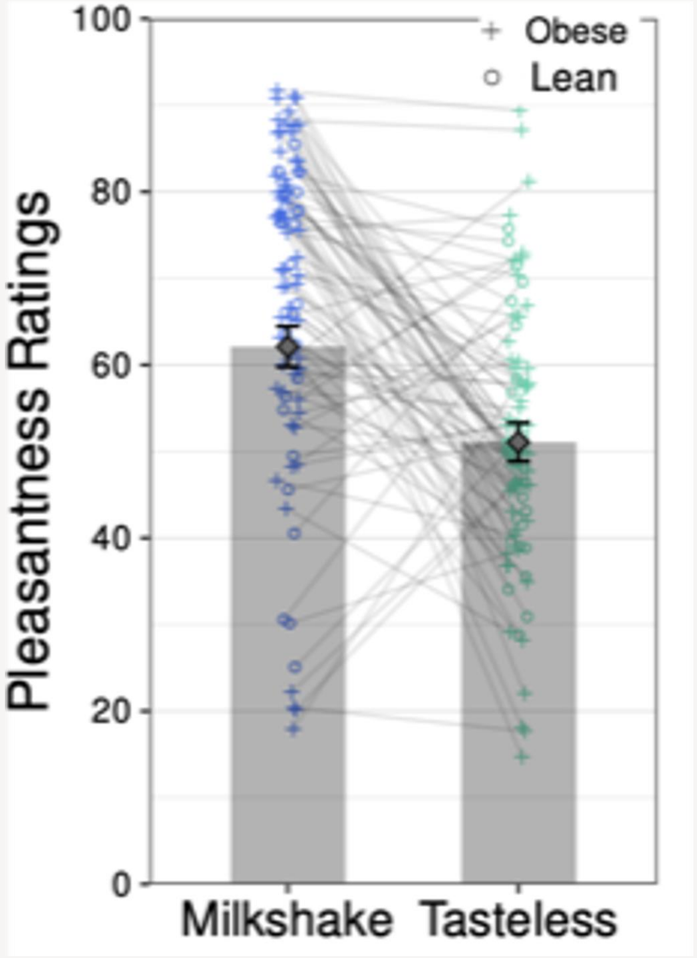
LIKING TASK



Fonds : Bourse de recherche de Novo nordisk

Coppin et al. (2023). *Int J Obes.*

NO EVIDENCE OF FOOD LIKING DIFFERENCE BETWEEN INDIVIDUALS WITH BMI BETWEEN 18.5 AND 24.9 AND INDIVIDUALS WITH BMI≥ 30



-***Taste: p < 0.001***

-*Taste*Group: p = 0.34*

-*Taste*Hunger: p < 0.001*

-*Taste*Intensity: p < 0.001*

-*Familiarity: p < 0.001*

Controlling for:

- Gender
- Age
- Familiarity
- Intensity
- Internal states (hunger, thirst, urinate)

Eccellenza grant from the SNFS

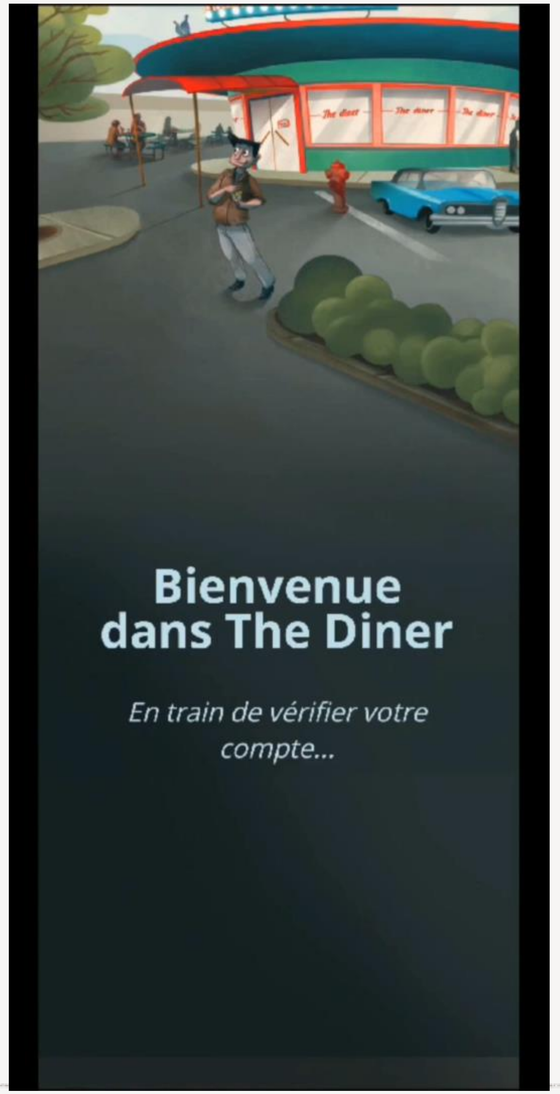
FNSNF
FONDS NATIONAL SUISSE DE LA RECHERCHE SCIENTIFIQUE

Coppin et al. (in preparation).

INTERMEDIATE SUMMARY

- Combination fat + carbohydrates : unique rewarding properties
- Differences in wanting between individuals of different BMI
  - Type and effort amount?
  - Other sub-components of reward?
  - Can we train them?

RESPONSE TRAINING TO MODIFY FOOD VALUATION



neuria

UNI FR

Fonds national suisse

Neuroscience
Programming
Videogame
Multimedia

Prof Dr L. Spierer, CEO
15+ ans chef de Laboratoire neurosciences

Dr H. Najberg, COO
PhD en psychologie & neurosciences

Dr M. Mouthon, Head of Technology
PhD en Science de la vie & ingénieurie

Dr M. Rigamonti, CTO
PhD en informatique & 15+ ans d'entrepreneuriat

Bs P. Rossel, Head of Design / UX
10+ ans de direction artistique et
développement de jeux vidéos

GENERAL METHODOLOGY

Pre-training measures

In-app calibration

Post-training measures

Training for 5 to 20 days

=

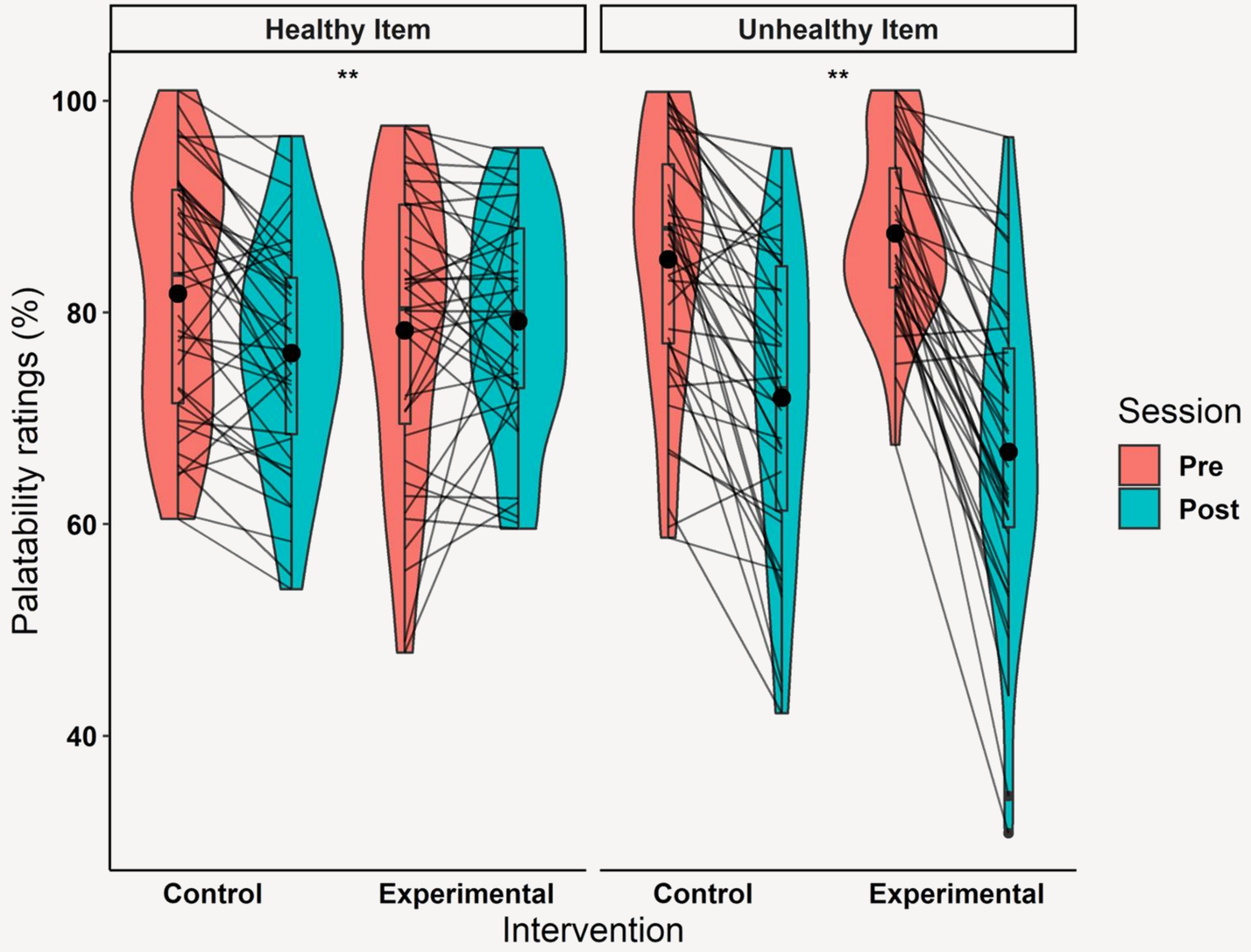
=

CHOICE OF GAMIFIED TRAINING

- Short single laboratory sessions
- Ouctomes in short term
- Tedious ; Little engagement
- Relatively small sample sizes

- **Tablet / Smartphone device** → online measures / monitoring / large-scale
- **High level gamification** → engagement for long intervention

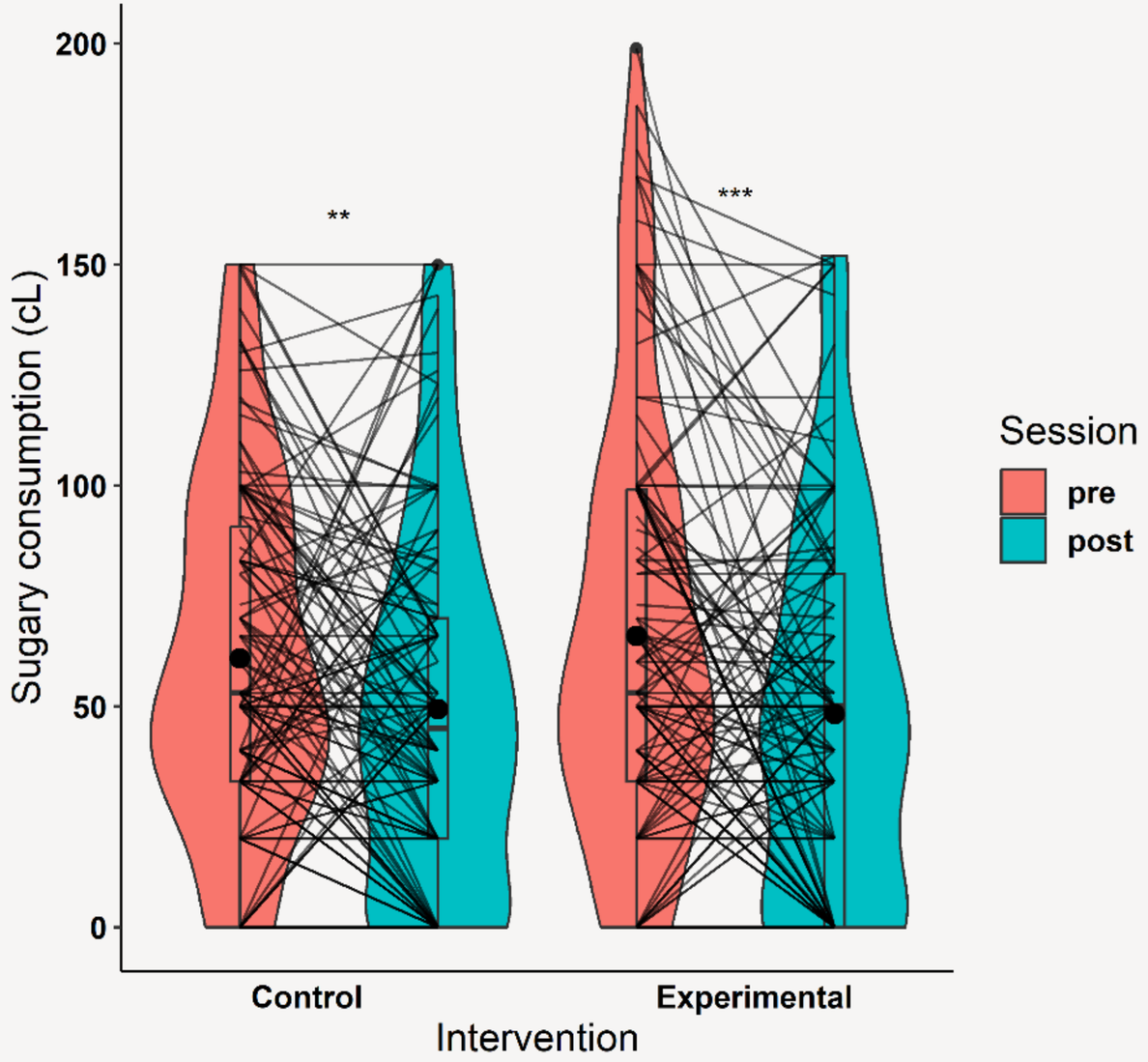
RESPONSE TRAINING REDUCES EXPLICIT LIKING



Registered report:

Najberg et al. (2021).
Royal Society: Open Science.

RESPONSE TRAINING REDUCES REPORTED CONSUMPTION



Registered report:

Najberg et al. (2023). *Scientific Reports.*

CONCLUSIONS

- Stop response -> « I like less »
- Stop response -> « I consume less »
- Does it increases the success of restrictive diet?

Registered report:

Najberg et al. (IPA).
PCI-RR.

- What is the neuroplasticity involved? (*better inhibitory control, reduced attention, reduced affective signal, etc.)*

Registered report:

Tapparel et al. (IPA).
Cortex.

THANK YOU!