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Neural and cognitive correlates of human decision-making in domestic energy usage

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Aims

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COGNITIVE

NEURAL

- **Measure implicit / unconscious attitudes towards nature** (important in influencing energy efficient decisions)

- **Measure conscious decisions about energy usage**: domestic heating energy choices – heat your home at its current comfort level, or adopt a more energy efficient approach (lower temperature)

Measure EEG (brain) activity during these tasks

Sample

- **N** = 30 (14 males, 16 females)
- **Age**: 18 – 45
- **Marital status**: 10 single, 13 married, 7 co-habiting
- **Work status**: 5 academics, 15 non-academic, 10 non-DCU
- 15 had no **children**
- **Accom type**: Apartment (5) Terrace (9) Semi-d (13) Detached (3)
- **Home age**: >60s (6), 70s-80s (5), 90s-00s (8), after 00 (9), other (2)
- **Fuel**: Gas (24) Oil (2) Elect (1) Combi (3)

- **Monitor use**: Bills (24) Gauges (2) Combination (3) Other (2)

Methods: questionnaires

- **Demographics**

- **Personality**
  - **Group Identification Scale**
  - **Locus of Control Questionnaire**
  - **Behavioural Inhibition Scale/Behavioural Activation Scale**

- **Attitudes**
  - **Connectedness to Nature Scale**
  - **New Ecological Paradigm**

Methods: Implicit Association Task

- Modified connectedness to nature **IAT** (adapted from Brunei et al.)

Congruent word associations
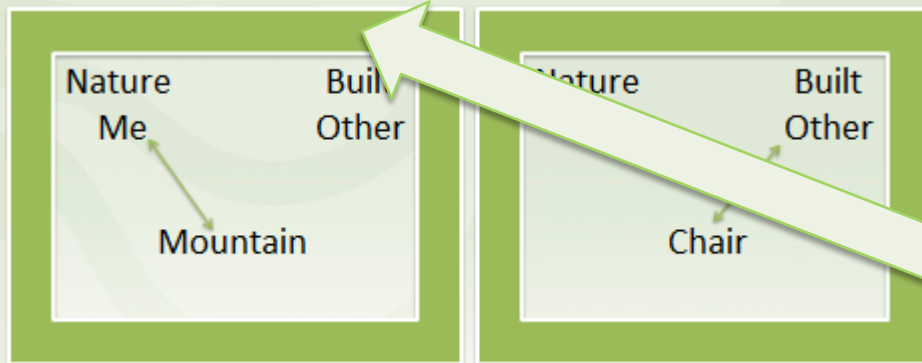
Key outcome?

D-score, based on RT differences between congruent and incongruent stimuli
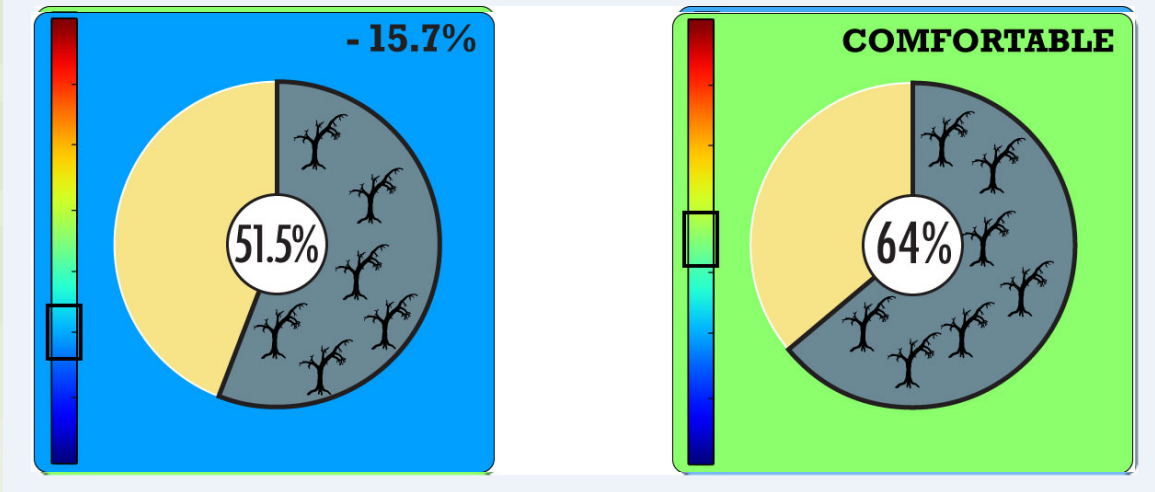

FASTER

Incongruent word associations

SLOWER

HIGHER D-SCORE

Methods: CPT

- Choice Preference Task

-15.7%

51.5%

COMFORTABLE

64%

Consciously decide – based on the information presented, would I stay at my comfort level, or would I change?

Key outcomes?

Change %

Nudge Factor (feedback):
Cost
Environment
Peers

Framing:
Positive
Negative

Temperature change:
Small
Big

Results:
IAT

Neural markers and IAT d-scores

IAT d-scores vs mV amplitude for Fz:(-60, -100)
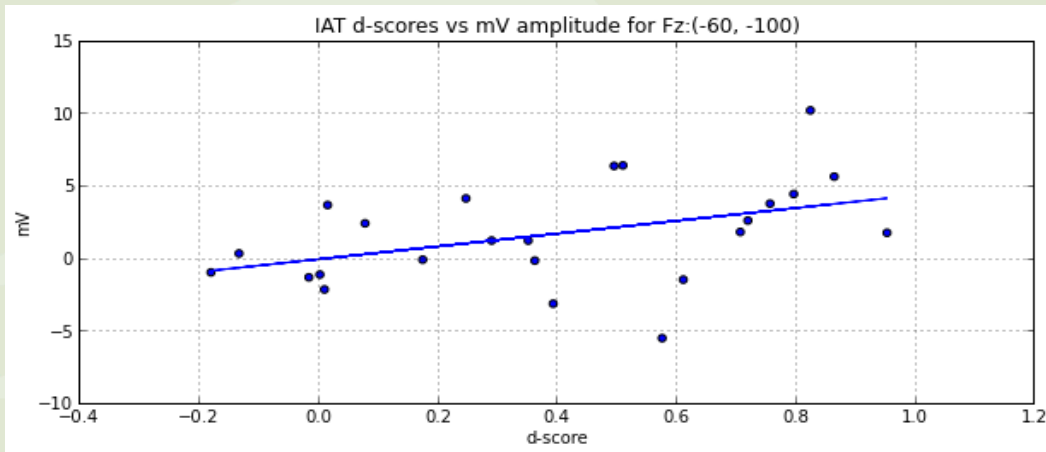
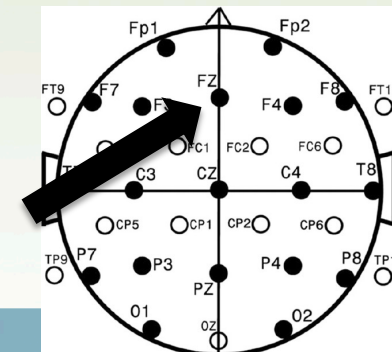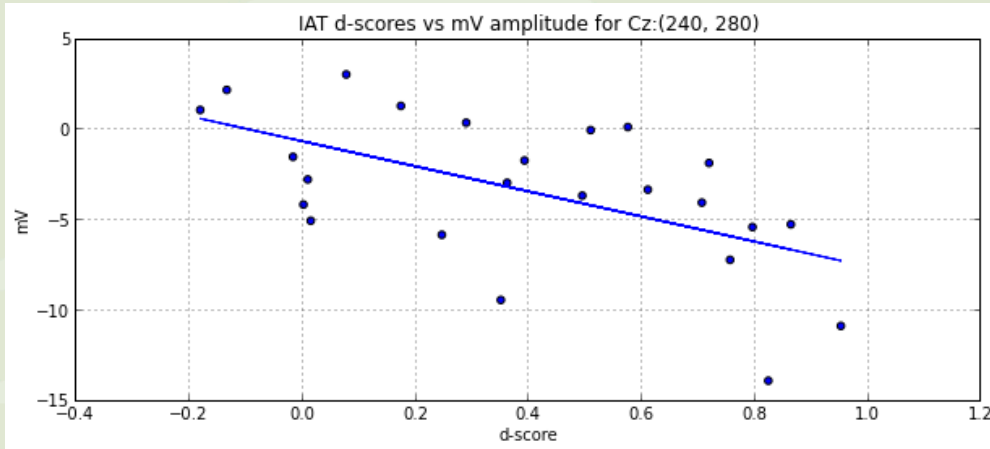**Significant**: Correlation between mV amplitude and IAT d-score in a time-region -60 → -100ms **prior to response** for channel Fz.
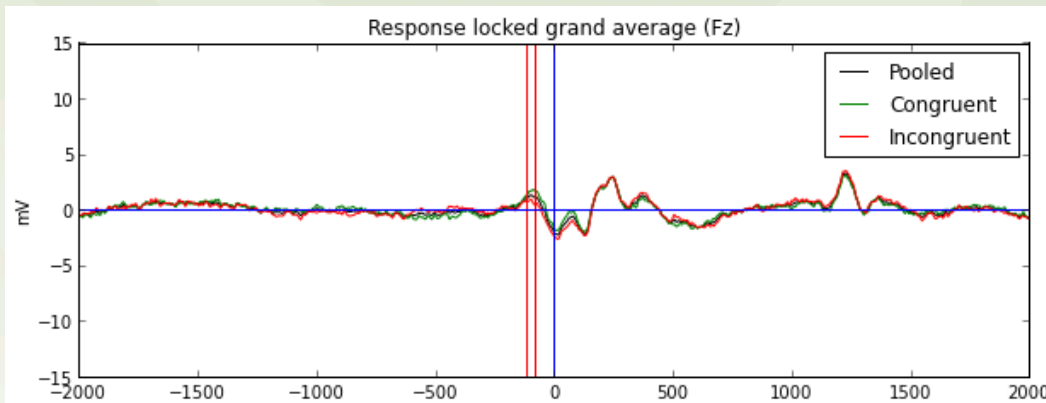
Response locked grand average (Fz)

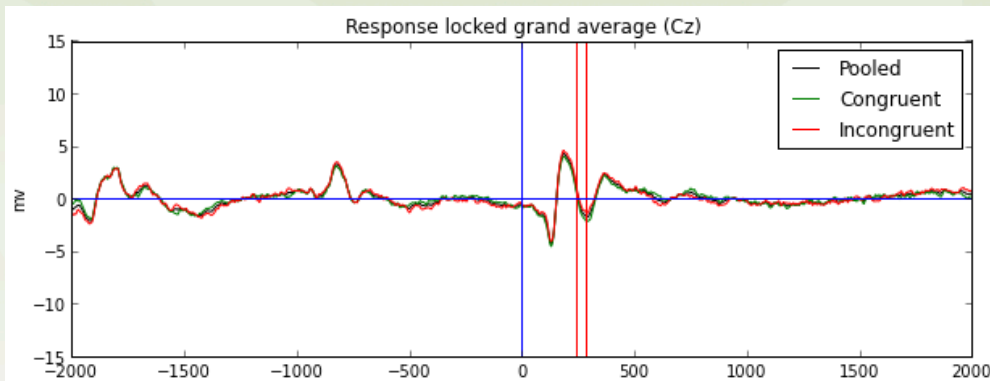Legend:
— Pooled
— Congruent
— Incongruent

Between the red vertical lines: time period examined for significant activity using spearman r. *(The blue line indicates the time of response)*

Neural markers and IAT d-scores

IAT d-scores vs mV amplitude for Cz:(240, 280)

Significant: Correlation between mV amplitude and IAT d-score in a time-region 240 ms → 280 ms following **stimulus onset** for channel Cz.

Response locked grand average (Cz)

Between the red vertical lines: time period examined for significant activity using spearman r. *(The blue line indicates the time of stimulus onset)*
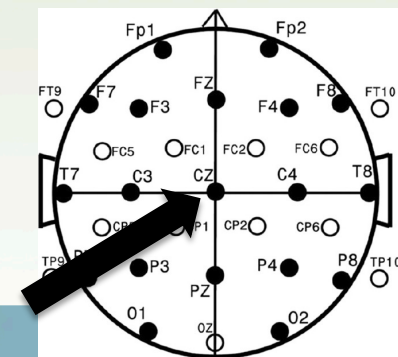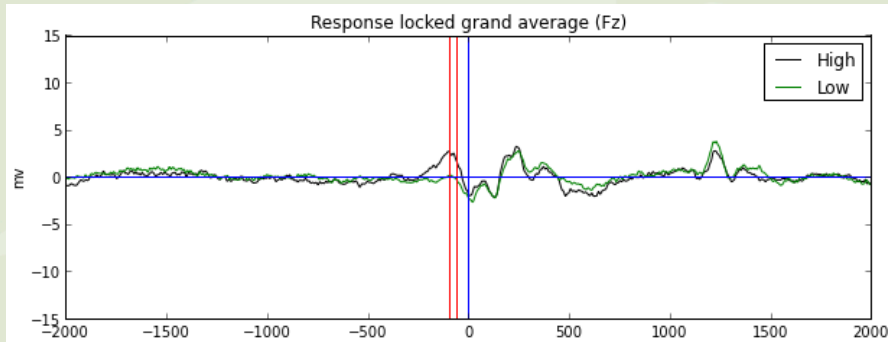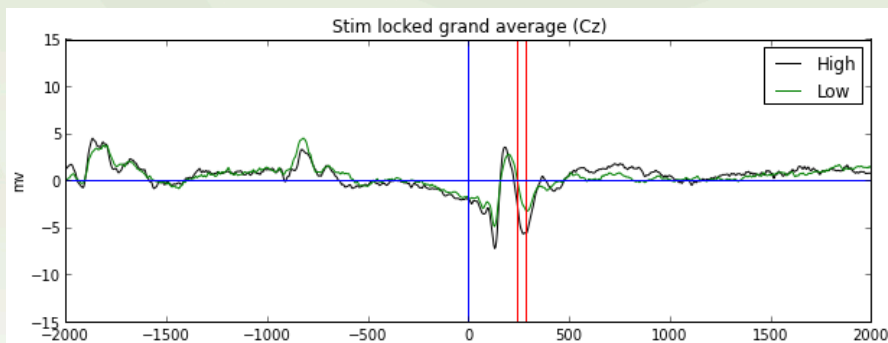
Neural markers and IAT d-scores: High vs Low d-scorers

Difference in ERP waveforms **response locked** on channel Fz between high and low d-scorers.

Between the red vertical lines we can see the time region that best differentiates between high and low d-scorers.

Difference in ERP waveforms **stimulus locked** on channel Cz between high and low d-scorers.

Between the red vertical lines we can see the time region that best differentiates between high and low d-scorers.

IAT summary

Key observation: We have found a set of **neural triggers** which can:

(1) **predict** d-scores

(2) **differentiate** between high and low d-scorers

(neural event before response at Fz, and after stimulus onset at Cz)

These represent two separate neural correlates which differentiate between d-scorer subtypes

Results:
CPT

Factors influencing response choice

Significant: More likely to make an energy efficient choice when **positively framed**

Significant: **Environmental information** > cost information > peer feedback

Less likely to make energy efficient choice when information provided that **peers** are behaving in an energy efficient way

Significant: More likely to make energy efficient choices when asked to make **small temperature change**

Reaction times to response choice

Significant: Faster responses to **positively framed**

Significant: Faster responses when **cost was framed positively** (savings) rather than negatively (lost savings)

Key Findings

Key Finding 1

Framing home heating decisions in positive terms (e.g. gains or rewards associated with this behaviour) significantly nudges participants to make an energy efficient decision.

The likelihood of making an energy efficient decision is greater when asked to **consider effects on the environment**. In contrast, one is less likely to make an energy efficient decision when provided with peer feedback.

Key Finding 2

IAT d-score:

is correlated with two neural triggers;

is correlated with the perceived influence of nudge factors that promote energy efficient behaviour (e.g. motivation to be more energy efficient; penalty and rewards associated with making an energy efficient decision);

is predictive of response times on CPT and exhibits a strong trend towards predicting particular types of choices.

Acknowledgments

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