The effects of a single administration of a moderate dose of caffeine on cognitive control and spontaneous EEG theta/beta ratio

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Ethical review	Approved WMO
Status	Recruitment stopped
Health condition type	Other condition
Study type	Interventional

Summary

ID

NL-OMON42339

Source
ToetsingOnline

Brief title
Caffeine and theta/beta ratio

Condition

- Other condition

Synonym
Not relevant

Health condition

Gezonde studenten

Research involving

Human

Sponsors and support

Primary sponsor: Universiteit Leiden
Source(s) of monetary or material Support: NWO Vidi beurs

Intervention

Keyword: Caffeine, Cognitive control, Theta/beta ratio

Outcome measures

Primary outcome

a) The change in performance (as measured with reaction times; RTs) on two cognitive tasks (n-back task & switch task) after caffeine consumption, relative to placebo consumption. We expect performance to improve (RTs to decrease) after caffeine consumption.

b) The change in the ratio between EEG measured theta and beta oscillations after caffeine consumption (relative to placebo consumption). We expect theta/beta ratio to decrease after caffeine consumption, thereby mediating the effects of caffeine on cognitive performance.

Secondary outcome

a) The moderating effects of baseline dopamine activity (measured with baseline spontaneous eye blink rates and theta/beta ratio) on the effects of caffeine on cognition.

b) The possible confounding effects of self-reported ADHD symptoms, sleepiness, and anxiety on the effects of caffeine on cognition.

Study description

Background summary

PFC-mediated cognitive control (which includes many processes such as attentional inhibition and emotion regulation) is thought to play an important role in cognitive functioning, allowing humans to exert top-down, goal-driven control over stimulus-driven, automatic processes. Previous EEG studies examining cognitive control have identified a potential biomarker for PFC-mediated cognitive control. These studies have found that the ratio between EEG-measured theta and beta brain oscillations is elevated in children with ADHD (a group of children who generally experience poor cognitive control), and in unselected adults with poor attentional control. This theta/beta ratio (TBR) is thought to reflect the extent to which prefrontal brain activity exhibits regulatory control over more posterior and subcortical brain areas. In the present study we propose a new method to further validate TBR as a biomarker for cognitive control, by administering caffeine to participants. Caffeine consumption improves cognitive control, which should lead to a decrease in TBR. In addition, the neurotransmitter dopamine plays an important role in PFC-mediated cognitive functioning, and may therefore moderate the relationship between caffeine consumption and cognitive control. In the present study, we will address this possible moderating role of dopamine by measuring participants* baseline theta/beta ratio, which is thought to reflect prefrontal dopamine activity, and spontaneous eye-blink rate, which is thought to measure central dopamine activity. Finally, in this study we will explore several other possible confounding factors in the relationship between caffeine consumption and cognitive control, including anxiety, sleepiness, and ADHD symptoms.

Study objective

The primary objective of this study is to further validate theta/beta ratio (TBR) as a biomarker for PFC-mediated cognitive control by administering caffeine. We hypothesize that caffeine will up-regulate PFC-mediated cognitive control, and thereby decrease TBR. The secondary objective of this study is to examine likely non-linear relations between caffeine, PFC-mediated cognitive functioning, and dopamine activity, by taking into account baseline theta/beta ratio and spontaneous eye-blink rates as moderating factors on the influence of caffeine on cognitive control. The tertiary objective of this study is to examine the possible confounding effects of sleepiness, anxiety, and ADHD symptoms in the effects of caffeine on TBR and cognitive control.

Study design

A double-blind, randomized, placebo-controlled, cross-over trial.

Intervention

Participants will visit the lab three times. In two lab sessions, separated by one week, participants will orally consume one capsule containing 200mg of pure caffeine (a similar amount of caffeine is found in about 2 cups of coffee) and one capsule containing a placebo filler substance (randomized and double-blind administration).

Study burden and risks

No risks are involved with participation in this study. The only burden for participants is investment of time and effort, for which they will be reimbursed. After caffeine consumption, participants may experience a temporary increase in effects associated with caffeine consumption (e.g. arousal, cognitive performance). No (other) benefits are expected to be experienced by the participants.

Contacts

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Trial sites

Listed location countries

Netherlands

Eligibility criteria

Age
Adults (18-64 years)
Elderly (65 years and older)

Inclusion criteria

- Female
- Age 18-25 years
- Consuming less than 100mg of caffeine (about one cup of coffee) per day on average
- Fluent in Dutch language

Exclusion criteria

- Severe physical or psychological morbidity that would adversely affect participation
- Habitual smoking
- Use of psychopharmaceutics

Study design

Design

Study type:	Interventional
Intervention model:	Crossover
Masking:	Double blinded (masking used)
Control:	Uncontrolled
Primary purpose:	Other

Recruitment

NL

Recruitment status:	Recruitment stopped
Start date (anticipated):	10-05-2016
Enrollment:	40
Type:	Actual

Ethics review

Approved WMO Date:	20-04-2016
Application type:	First submission
Review commission:	METC Leids Universitair Medisch Centrum (Leiden)

Study registrations

Followed up by the following (possibly more current) registration

No registrations found.

Other (possibly less up-to-date) registrations in this register

No registrations found.

In other registers

Register	ID
CCMO	NL55346.058.15