The neural basis of task-set preparation.

Published: 24-08-2006
Last updated: 20-05-2024

The primary objective of this study is to understand the neurocognitive basis of task-set preparation. To this end, we will acquire fMRI data and behavioural responses of healthy adults (aged 18-30 years).

Ethical review	Approved WMO
Status	Pending
Health condition type	Other condition
Study type	Observational non invasive

Summary

ID

NL-OMON30189

Source
ToetsingOnline

Brief title
The neural basis of task-set preparation.

Condition

- Other condition

Synonym
nvt

Health condition

focus op het gezonde brein

Research involving
Human

Sponsors and support

Primary sponsor: Universiteit Leiden
Source(s) of monetary or material Support: Ministerie van OC&W

Intervention

Keyword: fMRI, preparation, task-switching

Outcome measures

Primary outcome

In line with previous research (e.g., Rogers & Monsell, 1995), we expect that reaction times will be longer and error rates higher on task-switch as compared to task-repetition trials. Furthermore, this switch cost will decrease with longer preparation intervals.

Following presentation of the cue, we expect to find increased activity in task-specific areas in the occipito-temporal cortex (fusiform face area and visual word form area), parieto-occiptal brain areas that code for the location of the upcoming stimulus, and motor cortex contralateral to the task-relevant hand.

We will perform several analyses (e.g., using bin analyses or cross-subject correlations) to investigate whether, as we expect, preparatory activity in task-specific areas predicts performance on the corresponding trials.

Secondary outcome

n/a

Study description

Background summary

Task-switching has recently become a popular paradigm for studying executive control. Participants are required to switch back and forth between two choice

reaction time (RT) tasks afforded by the same class of stimulus. For example, participants might have to switch between classifying colored shapes by color or by shape, or between classifying digits as odd/even or high/low. The task to be performed on a given trial is determined by a visual cue presented prior to each stimulus. The cue-stimulus interval provides a prepara¬tion interval during which, on a switch trial, we might expect participants to attempt to reconfigure their cognitive processes for the changed task. The most basic observation is that changing tasks incurs a switch cost: mean RT is longer (and error rate usually greater) when the task changes than when the same task is performed as on the previous trial (Allport et al., 1994; Rogers & Monsell, 1995). Of particular interest here is the effect of the preparation interval on the switch cost. As the preparation interval increases up to about half a second, there is typically a substantial reduction in switch cost -- the preparation effect (Meiran, 1996; Nieuwenhuis & Monsell, 2002).

What mental process does the preparation effect reflect? In other words, what do subjects do during the preparation interval that causes them to be more prepared when the stimulus arrives? Two classes of theory have been offered. According to Rogers & Monsell*s (1995) task-set reconfiguration theory, the preparation effect is an index of an endogenously-triggered control process of task-set reconfiguration*a sort of mental *gear changing**carried out by the subject prior to the stimulus onset. Task-set reconfiguration can include shifting attention between stimulus attributes or elements, retrieving goal states (what to do) and condition*action rules (how to do it), enabling a different response set and adjusting response criteria. Task-set reconfiguration may well involve inhibition of elements of the prior task set as well as activation of the required task set.

According to priming theory (Logan & Bundesen, 2003; Schneider & Logan, 2005), subjects can perform task-switching experiments using a single, general task set, and switch costs reflect cue-encoding benefits, not endogenous task-set reconfiguration. This theory exploits a peculiar feature of cued task-switching procedures: The cue and the imperative stimulus can be treated as a compound stimulus that uniquely determines the correct response. For example, the cue Odd-Even and the stimulus 7 map uniquely onto one of the response buttons. From this perspective, there is no endogenous act of control that prolongs RT on task switch trials. Instead, there may be a benefit from repeating the cue*part of the compound stimulus*on task repetition trials. Priming theory explains the benefit from repeating the cue in terms of memory retrieval and the principles that govern it, including repetition priming. The preparation effect reflects the operation of these elementary memory processes during the preparation interval.

It has proven hard to distinguish between the task-set reconfiguration theory and priming theory on the basis of behavioral experiments (e.g., Monsell & Mizon, in press). However, the two theories make distinct predictions with regard to patterns of brain activity during the preparation interval. Task-set reconfiguration theory predicts that the preparation interval should be characterized by preparatory activity in the brain areas associated with the relevant task set, that is, the various perceptual, cognitive, and motor

components of the upcoming task. Furthermore, this preparatory activity should be predictive of subsequent task performance. Priming theory denies the importance or existence of such task-specific preparatory activity, and instead posits that the same elementary memory processes are active during the preparation interval, regardless of which task has to be performed. The proposed research attempts to test between these predictions using event-related fMRI.

Study objective

The primary objective of this study is to understand the neurocognitive basis of task-set preparation. To this end, we will acquire fMRI data and behavioural responses of healthy adults (aged 18-30 years).

Study design

Participants will perform a simple task-switching experiment while fMRI data is acquired. The study has the purpose to understand how preparation for a particular task is reflected in functionally distinct brain areas (see protocol for details)

Study burden and risks

There are no known risks associated with participating in an fMRI study. This is a noninvasive technique involving no catheterizations or introduction of exogenous tracers. Numerous children and adults have undergone magnetic resonance studies without apparent harmful consequences. Some people become claustrophobic while inside the magnet and in these cases the study will be terminated immediately at the subject's request. The only absolute contraindications to MRI studies are the presence of intracranial or intraocular metal, or a pacemaker. Relative contraindications include pregnancy and claustrophobia. Subjects who may be pregnant, who may have metallic foreign bodies in the eyes or head, or who have cardiac pacemakers will be excluded because of potential contraindications of MRI in such subjects. Although there is no direct benefit to the participants from this proposed research, there are greater benefits to society from the potential knowledge gained from this study. An important factor of successful human functioning is the ability to rapidly shift between various tasks, an ability that if often compromised in older adults and other neurologically impaired groups. The proposed research will lead to a better understanding of task-set preparation and its implementation in the brain.

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

Adult subjects (18 -30 years of age) with no history of neurological disorder/disease and no counter-indications to MRI will be included in this study. All participants will be right-handed native Dutch speakers with normal vision or contact lenses.

Exclusion criteria

Potential participants will be prescreened for contra-indications for fMRI, which include metal implants, heart arrhythmia, claustrophobia, and possible pregnancy (in adult females). They will additionally be prescreened for head trauma, premature birth, learning disabilities, and history of neurological or psychiatric illness and/or use of psychotropic medications. Because of the difficulties in interpreting cognitive studies in subjects with Dutch as a second

language, only native-Dutch speakers will be asked to participate in the study. Finally, left-handed individuals will be excluded from the study because some left-handers have substantially different brain organization relative to right-handers.

Study design

Design

Study type: Observational non invasive

Masking:	Open (masking not used)
Control:	Uncontrolled
Primary purpose:	Other

Recruitment

NL

Recruitment status:	Pending
Start date (anticipated):	01-09-2006
Enrollment:	24
Type:	Anticipated

Ethics review

Approved WMO

Application type:	First submission
Review commission:	METC Leiden-Den Haag-Delft (Leiden) metc-ldd@lumc.nl

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	NL13247.058.06