The Neural Mechanisms involved in Conflict and Reward Processing

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

Summary

ID

NL-OMON34864

Source
ToetsingOnline

Brief title
Conflict and Reward Processing

Condition

- Other condition

Synonym
nvt

Health condition

gezonde brein

Research involving
Human

Sponsors and support

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

Intervention

Keyword: conflict, fMRI, reward

Outcome measures

Primary outcome

The main study parameters are the significant clusters of brain activation associated with conflict, those associated with reward, and those associated with interactions between conflict and reward. The main behavioral study parameter is conflict-driven decreases in interference measured by response times as a function of reward (cf. Egner, 2007).

Secondary outcome

n/a

Study description

Background summary

The experience of cognitive conflict is known to trigger control improvements (Botvinick et al., 2001; Gratton et al., 1992). Executive control can be measured by classical paradigms like the Stroop and the Flanker task. In the Flanker task, for example, subjects respond to target stimuli while ignoring irrelevant distractor stimuli. Given that distractors can often not be filtered out completely, they typically create conflict, especially if they suggest a different response than the actual target. For instance, if participants respond to a central visual target surrounded by visual distractors, they perform better if target and distractor call for the same response (congruent trials) than if they call for different responses (incongruent trials). It has been shown that conflict produced during demanding incongruent trials recruit neural conflict monitor mechanisms which drive adaptations in top-down informational control (for a review, see Egner, 2007). This effect has been

demonstrated both by improved behavioral performance and neural activation reflecting increased goal representations and task-relevant information (Egner & Hirsch, 2005; Kerns et al., 2004). A so-called conflict-control network involving the anterior cingulate cortex (ACC) and dorsolateral prefrontal cortex (dl-PFC) is thought to underlie conflict-driven control adaptations (Egner & Hirsch, 2005).
A recent series of studies aims to identify the affective component involved in cognitive conflict (e.g. Botvinick, 2007; van Steenbergen et al., 2009). It has been suggested that conflict is processed like an aversive event and may drive phasic dips in mesolimbic dopamine levels (Jocham & Ullsperger, 2009). Indeed, recent studies by the authors have shown that conflict can be counteracted by rewarding events (van Steenbergen et al., 2009; van Steenbergen et al., 2010a; van Steenbergen et al., 2010b). These studies thus suggest that rewarding stimuli may counteract conflict processing by neural interactions between the mesolimbic reward system and the conflict-control network. The current study aims to test this prediction.

Study objective

The primary objective of this study is to understand the neurocognitive basis of conflict and reward processing and their interactions. To this end, we will acquire fMRI data and behavioral responses of 25 healthy female adults (aged 18-30 years).

Study design

Stimuli
To measure conflict processing we will use a variant of the classical Eriksen Flanker task (Eriksen & Eriksen, 1974). Subjects have to respond to a central arrow target while ignoring flanking distracters. Conflict is manipulated by using flankers that are either congruent (C) or incongruent (I) with the target. Following previous studies (Egner, 2007), neural and behavioral data will be analyses as a function of conflict on the current trial and adaptations following conflict on the subsequent trial.
To provide rewarding events subjects will view emotionally positive stimuli, after which they perform a short sequence of flanker trials. Humor cartoons will be used that have been shown to recruit reward-related brain areas. As a control condition we use neutral cartoons which are created by removing the funny cues of the original humor cartoons. Stimuli are matched for visual characteristics (cf. Mobbs et al., 2003; van Steenbergen et al., 2010a).
Each cartoon is presented for 6 s and is - after a jittered interval of 4 s - followed by a series of 5 flanker stimuli each presented for 1 s and followed by a jittered interval of 4 s.
Trial types will be presented intermixed, in a pseudorandom order.
Procedure
The proposed study will consist of one experimental session within the MRI

scanner. It is followed by humor ratings of the cartoons and validated questionnaires measuring individual differences in reward sensitivity (e.g. BIS-BAS scale; Franken et al., 2005) outside the scanner. Total scanning time will constitute maximal 60 minutes. The total duration of the experiment, including the questionnaires, will be approximately 90 minutes.
While fMRI data is acquired, participants perform the tasks as described above in blocks of about 5 minutes followed by short breaks. Subjects are instructed to perform the flanker task as fast and accurate as possible. After the experiment, they will be fully debriefed about the purpose of the experiment and will be given monetary compensation.
Data acquisition
MRI scanning will be performed at the Leiden imaging center, located in the radiology department of the LUMC. Data will be acquired on the 3T Philips scanner. Standard fMRI procedures will be adopted. Whole-brain structural images will include high-resolution Fast Spin Echo scans that will be used for fMRI localization. Functional images will be acquired using standard LUMC scanning parameters
fMRI analysis
Primary analyses investigate BOLD responses to conflicting Flanker stimuli in interaction with cartoon processing.
1. In keeping with previous research (cf. Egner, 2007), neural conflict processing is analyzed using a 2 x 2 design including the factors Current Trial Conflict (I vs C) and Previous Trial Conflict (i vs c).
2. In keeping with previous research (Mobbs et al., 2003), individual humor ratings of cartoons are used as regressor.
3. Contrasts also compare predicted interactions between conflict (1) and reward (2)
Expectations for behavior
We expect that our behavioral findings will replicate our earlier pilot study (van Steenbergen et al., 2010a). Accordingly, conflict-driven increases in executive control (measured by reduction in interference effects in response times) are expected to be reduced by rewarding stimuli in comparison to the neutral stimuli.
Expectations for brain activity
1. In keeping with previous research (Egner & Hirsch, 2005; Kerns et al., 2004), we expect conflict monitoring activity during demanding flanker trials, which is reduced if the preceding trial evokes conflict. Conflict-driven goal activation is thought to involve dorsolateral prefrontal areas.
2. In keeping with previous research (Mobbs et al., 2003), rewarding stimuli are thought to activate brain areas that play a central role in reward processing (i.e., the mesolimbic dopamine system).
3. Interactions between (1) and (2) are predicted to show that reward processing counteracts conflict processing.

Study burden and risks

Risks:

There are no risks associated with behavioral testing except the occasional possibility of some boredom or fatigue. Testing will stop if a subject displays frustration or appears tired.
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 human subjects have undergone magnetic resonance studies without apparent harmful consequences. Radiofrequency power levels and gradient switching times used in these studies are within the FDA approved ranges. Some people become claustrophobic while inside the scanner and in these cases the study will be terminated immediately at the subject's request. The only absolute contraindications to MRI studies are metal implants, intraocular metal and heart arrhythmia. 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.
Benefits:
Although there is no direct benefit to the participants, the proposed research is expected to make a significant contribution to our understanding of the neural mechanisms underlying conflict and reward processing. Ultimately, this can be beneficial for various practical purposes, including the treatment of mood disorders which are associated with dysfunctional conflict and reward processing. In terms of scientific contribution, the study will be the first study to investigate the neural basis of interactions between reward and conflict processing.
The importance of the benefits gained from this research far outweighs the minimal risks involved.

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

Adults female 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 contraindications for fMRI, which include metal implants, heart arrhythmia, claustrophobia, and possible pregnancy (in females). They will additionally be prescreened for head trauma, history of neurological or psychiatric illness and/or use of psychotropic medications. We only investigate female subjects because previous research has shown that they are more sensitive to the reward stimuli used in our study (Azim et al., 2005). Given that humor appreciation often is mother-tongue specific, 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:	Recruiting
Start date (anticipated):	01-04-2010
Enrollment:	25
Type:	Actual

Ethics review

Approved WMO

Date:	03-03-2010
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	NL31442.058.10