Early neuronal processing of basic tastes in healthy young adults and elderly, investigated with fMRI.

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Ethical review	Approved WMO
Status	Recruitment stopped
Health condition type	Appetite and general nutritional disorders
Study type	Observational invasive

Summary

ID

NL-OMON39437

Source
ToetsingOnline

Brief title
Early basic taste processing

Condition

- Appetite and general nutritional disorders

Synonym
physiological processing of taste, Taste disturbance

Research involving
Human

Sponsors and support

Primary sponsor: Universitair Medisch Centrum Groningen
Source(s) of monetary or material Support: Campina,Nutricia,Top Institute Food and Nutrition

Intervention

Keyword: Elderly, fMRI, Gender differences, Taste

Outcome measures

Primary outcome

The outcomes of the study will consist of:

- The neural activity due to the ingestion of the basic tastes: sweet salty,

sour and/or bitter.

- The behavioral response related to them.

- The results of the application of machine learning and other cognitive

modelling techniques to these data (behavioral + brain activity).

- A description of the functional organization within the brain as a function

of the early neuronal processing of to basic tastes.

- A description of the emotional reactions and its temporal dynamics.

Secondary outcome

Not applicable.

Study description

Background summary

Previous studies indicate that the gustatory cortex (Insula & overlying Operculum) plays an important role in taste processing. Manipulations in pleasantness, taste identity, taste intensity or physiological state (hunger or satiety) were all associated with activity changes within the gustatory cortex. Where identification was recorded in the anterior insula and overlying frontal operculum (AIFO), pleasantness was recorded in the mid insula and intensity was associated with increased BOLD responses in the insula. Furthermore, the physiological state of hunger also showed to increase activity in the insula, compared to being satiated.
So far no study has shown a specific chemotopy within the gustatory cortex

for the different basic tastes in humans. Results from primate studies show similar results. Single cell recordings in primates indicate that neurons in the gustatory cortex are broadly tuned; they responded to more than one taste stimulus. This could imply that rather a network of neurons is representing the identity of a basic taste. In rodents this indeed seemed to be the case. However, these activation patterns do not represent identification alone. It was also shown that tastes with a similar hedonic value activate more common regions in rodents. Furthermore it was shown that the activation pattern of saccharin is plastic: by means of a conditioned taste aversion paradigm, the activation pattern of saccharin changed and showed activity in regions that are similar to the activity regions of unpleasant tastes.
By specifically zooming on the gustatory cortex we aim to investigate the activity patterns that are associated with (interactions between) taste identity, intensity and hedonic value with a higher spatial resolution. This in order to build a better understanding on the functional organization of the gustatory cortex of healthy people. Furthermore, we aim to indicate where the differences are between both men and women and young adults and elderly. This information is vital in order to further investigate the neuronal changes induced by chemosensory disturbances such as disturbances caused by undergoing chemotherapy or by aging.
With a higher spatial resolution and including different taste identities, intensities and pleasantness, we hypothesize that we are able to find a more specific functional organization in the gustatory cortex and specific correlations with other regions within the brain stem, basal ganglia and midbrain. Based on animal models we expect to find activity patterns that overlap based on pleasantness. Furthermore, if the anterior insula and overlying operculum can indeed be associated with taste identity we expect correlations with memory regions such as the hippocampus. We also expect that activity regions that can be associated with pleasantness show correlations with activity with emotion regions such as the amygdala.

Study objective

This study will form the basis for future studies that are planned to investigate chemosensory disturbances in elderly and testicular cancer patients who are undergoing cisplatin based chemotherapy within the University Medical Center Groningen. Being able to investigate these changes requires insight in how the neuronal activation behaves in healthy patients.
Together with the previously approved study METc2011.151; ABR: Nl36783.042.11 we aim to model the different attributes of tastes based on the measured brain activity and by employing machine learning techniques. This model will constitute a second objective of this study.
Furthermore there is little known about the neuronal processing of taste stimuli in elderly. Therefore we also aim to pinpoint the functional changes during taste processing in elderly.

Study design

Participants will be subject to the following paradigms:

1) Participants who are interested in taking part in the study will first undergo a screening by telephone. During the screening the inclusion and exclusion criteria for both the experiment and MR compatibility will be discussed. Furthermore the experiment will be discussed briefly and any questions will be answered. The intake by telephone will end with arranging an appointment for the first visit.

2) During the intake the experimental paradigm will be shown to the participant in order to get familiar with it. Furthermore the participant will take place in a dummy scanner to factor out any effects of claustrophobia. Participants will also undergo 2 small tests, both consisting of ±10 minutes each. These are a saliva test and a taste threshold test. The saliva test will indicate how much saliva the participant produces during normal circumstances and during chewing (stimulation). Also we will determine the amount of proteins that are present in the saliva. The taste threshold test will involve tasting taste strips and recognizing the taste of the strip. This test will ensure that the participant is not experiencing abnormalities in his or her taste perception. The outcomes of both these tests will contribute to the interpretation of the results from the MRI experiment.
At the end of the intake visit an appointment will be made for the MRI experiment. For this new appointment, young women will be asked to keep using there hormonal anti conceptive, to ensure hormone levels will be constant.

3) During the MRI experiment the participant will be scanned in a 3 Tesla MR scanner. During the fMRI experiment the participant will administer the different tastes. These tastes are presented in liquid form with a volume of 2mL per administration. After receiving the taste, the participant is asked to rate the pleasantness of the taste by means of a button box. When the pleasantness is rated, a rinsing trial will commence to wash away the existing taste in the mouth. Rinsing will be done with a solution of artificial saliva in water, with a total volume of 2mL.

4) Scanning will take place in either the morning or at the end of the afternoon. The participant will be asked to stop eating after at least two hours before the experiment begins.

The complete dataset will be composed by behavioral data (the pleasantness and intensity ratings) as well as by brain activity data (recorded MR images). Additionally, an high-resolution anatomical MR scan will be used to match the brain activity with brain structures at an individual level.

The analysis of the data will include:

- Standard preprocessing of the MR data. This will include realignment, coregistration between functional and anatomical data, normalization and spatial smoothing.
- Single subject analysis of brain activity by looking at the differences between conditions (e.g. the difference between the basic tastes), as well as the differences between the experience of a taste and the baseline activity of the brain (i.e. looking at a fixation cross). The results of the behavioral data will be included as covariates.
- Application of machine learning techniques and/or other cognitive modelling techniques to the combined brain activity and behavioral response data.
- Group analysis of the results collected at single subject level, using both parametric and non parametric techniques.

Study burden and risks

- The exposure to a Magnetic Resonance environment is not considered harmful per se.
- The insurgence of a claustrophobic feeling is not uncommon; in order to reduce this risk, we (a) ask the participant about being prone to claustrophobia, and (b) when desired, we will put the participant in a dummy scanner (a far lesser stressful environment) before to exposition to the real MR environment.
- During the scanning sessions the participants receive small amount of liquids in their mouths (2mL); this could provoke, in cases of mis-swallowing, coughing. It is very unlikely that this will invoke a life threatening situation. Furthermore an experimenter will stand next to the subject to provide the taste stimuli and will constantly observe the well-being of the participant. Besides, the participant will have the ability to control an emergency button which will stop the scanning procedure.

We believe that for the present study the ratio between the possible increase of knowledge on the one hand and the burden/risk on the other hand is favorable. It is an acknowledged fact that Magnetic Resonance is an eminently risk-free investigational tool.

This study promises to shed light on the inner mechanisms of how the human brain reacts to basic tastes. Furthermore, this study will form the basis for future studies that are planned to investigate chemosensory disturbances in elderly and testicular cancer patients who are undergoing cisplatin based chemotherapy within the University Medical Center Groningen. This study will help understanding these problems and, ultimately, contribute to a healthy diet, which is of vital importance for survival of these patient groups.

About the benefits for individual participants: there are no direct benefits. However, they will benefit from an early detection if any structural abnormalities are detected at the level of their 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

Caucasian
Age range young: 18-30
Age range elderly: 60-75
Young women: using hormonal anti conceptives

Exclusion criteria

MR incompatable (posibility of any incompatible metal objects inside the body)
History of psychiatric disorders
History of taste-related disorders
Smokers

Wearing glasses (lenses are allowed)
Alcohol/drug abuse
Pregnancy
Users of removable dentures, will be asked to remove these before the experiment.

Study design

Design

Study type: Observational invasive

Masking:	Single blinded (masking used)
Control:	Uncontrolled
Primary purpose:	Other

Recruitment

NL

Recruitment status:	Recruitment stopped
Start date (anticipated):	07-01-2013
Enrollment:	80
Type:	Actual

Ethics review

Approved WMO Date:	09-10-2012
Application type:	First submission
Review commission:	METC Universitair Medisch Centrum Groningen (Groningen)
Approved WMO Date:	12-02-2013
Application type:	Amendment
Review commission:	METC Universitair Medisch Centrum Groningen (Groningen)

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	NL38289.042.12