Humour, Laughter and Exhilaration studied with functional Magnetic Resonance Imaging (fMRI)

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Introduction: According to two recent studies employing functional magnetic resonance imaging (fMRI), the processing of humour appears to be correlated with brain activity in the left middle- and inferior temporal gyri, the right middle temporal gyrus, the left inferior frontal gyrus, the cerebellum (1), Broca's area and the middle frontal gyrus (2). It has also been observed that humour-related laughter could be induced by stimulating the supplementary motor cortex (in an epileptic girl undergoing monitoring with subdural electrodes (3)). Against this background, we have begun to attempt to differentiate the brain's activity during: exhilaration, the perception of verbal humour, and overt laughter using fMRI.

Methods: Five young, right-handed volunteers were presented with two sets of recorded auditory stimuli (via earphones) while lying in an fMRI apparatus. Throughout both experiments, subjects were requested to consciously exhibit the exhilaration and/or the humour that they were experiencing via their "natural" facial expressions (i.e. by smiling and/or laughing at corresponding intensities). They were, however, also requested to inhibit laughter-induced head-movements. To facilitate this, their heads were immobilised in a plastic shell with an elastic band. In order to correlate the subjects' emotional states on a second-by-second basis with the fMRI measurements, the face of each subject was continually monitored by an MR-compatible video camera (4). See *Fig. 1*. The first set of stimuli consisted of recorded laughter interspersed with periods of silence and "white noise". About half-way through the period of laughter, the subjects were requested to "inhibit your laughter and feelings of exhilaration." The second set of stimuli consisted of short humorous readings, alternating with neutral readings (weather reports, for example). A diagram of these two protocols is presented in *Fig. 2*.

Figure 1: *Subject in MR tunnel as seen with the video camera.*

Figure 2: *Diagram of protocols for Experiments 1 and 2*

Experiment 1

Pause: 1 Min. 9.6 Sec.	**Recorded laughter:** 5.0 Min **Last 2 Minutes: "Suppress your exhilaration and/or laughter"**	**Pause:** 1 Min. 9.6 Sec.	**Recorded laughter:** 5.0 Min. **Last 2 Minutes: "Suppress your exhilaration an/or laughter"**	**Pause:** 1 Min. 9.6 Sec.	**"White noise":** (acoustic control) 2.0 Min.	**Pause:** 1 Min. 4.8 Sec.	

Experiment 2

Pause: 1 Min. 1.6 Sec.	**Neutral reading:** 1 Min. 32.4 Sec.	**Funny reading:** 1 Min. 32.4 Sec.	**Neutral reading:** 1 Min. 32.4 Sec.	**Funny reading:** 1 Min. 32.4 Sec.	**Neutral reading:** 1 Min 32.4 Sec.	**Funny reading:** 1 Min. 32.4 Sec.	**Neutral reading:** 1 Min. 32.4 Sec.	**Grin (muscle control)** 1 Min. 1.6 Sec.	**Pause :** 1 Min. 1.6Sec .

At the end of each session, the subjects were interviewed via a standardised questionnaire to determine the emotions they had experienced during the various stimuli. fMRI of the whole brain was performed with a 1.5 Tesla tomograph (Siemens Sonata) using echo planar imaging (28 slices, slice thickness 4 mm, 64 x 64 matrix, acquisition time 3 seconds). Statistical evaluation of the groups (realignment, coregistration, smoothing <8 mm> and normalisation) was carried out with SPM99b (Wellcome Dept. of Cogn. Neurol., London) in a combination of block diagram and event-related modes. Only the block-diagram results are presented in this poster.

Results:

In both experiments, video data of the subjects' facial expressions showed a satisfactory degree of correspondence between the stimuli being presented and their responses. This correspondence was, however, higher in Experiment 1 than in Experiment 2.

Experiment 1: In response to recorded laughter, all subjects reported having been induced into a state of exhilaration which they could voluntarily inhibit. Unfortunately, however, the laughter-associated head movement of one of the subjects was so pronounced that the movement-correction programs employed were no longer sufficient to the task and his data could not be evaluated for this part of the experiment. In the other four subjects, maximal differences between "exhilaration" and "inhibition of exhilaration" were observed in the right frontobasal region (x = -54, y = 12, z = 9; T = 4.67). See below.

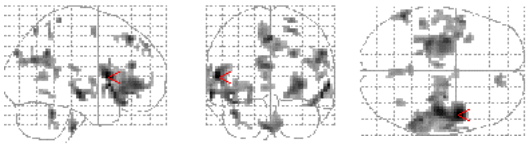

Figure 3: *Active areas during "Exhilaration" (induced by listening to recorded laughter) vs. voluntary "inhibition of exhilaration."*

Experiment 2: The responses to the second set of stimuli: "humorous" vs "neutral" readings were less uniform. Some subjects tended to either laugh/smile over several sessions; others remained relatively non-responsive. Verbal reports confirmed this inconsistency. Despite this, there were highly significant differences in brain activity during the humorous vs. the neutral readings. The maximum activity for this contrast was observed was in the right temporal lobe (x = 45, y = 3, z = -25; T = 13.3). See below.

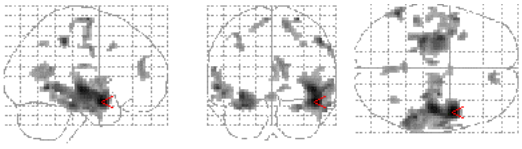

Figure 4: *Active areas during humorous vs. non-humorous readings.*

Discussion: Although no activations were observed in the supplementary motor cortex (3), the activations seen in Figures 3 and 4 are in partial agreement with results from other recent studies (1,2). In this first attempt to study exhilaration per se, it was found to be associated with frontobasal activity; the perception of verbal humour with activations in the right temporal lobe (see also 2 and 3). Further studies will be necessary to differentiate and explore the perception of humour in its multitude of forms as well as the varieties of responses to it.

References:

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