Looking for Information Relevance in the Brain

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The main goal of users engaged in information search is to retrieve *relevant* information. Relevance is a fundamental concept for information science and information retrieval. Relevance can be considered from two main perspectives, system and human (Borlund, 2003). Of our interest is the second kind of relevance that has been conceptualized as the user's judgment of the strength of the relationship between a document and the user's information need (e.g., Saracevic, 1975). Relevance judgments are important events during interaction with a search system. They can indicate user's interest, user's progress in a task, and reflect the search system's effectiveness. In experiments relevance is often measured in terms of cognitively-mediated explicit actions, such as saving a document, or through self-assessments of content relevance. Direct and non-intrusive detection of relevance judgements would provide an objective and deeper means to capture this important aspect of the user's mental state while in the 'flow' of search and so enable study of search behaviour in natural settings.

Cortical correlates of relevance decisions have received some attention. For example, Wakusawa et al. (2009) conducted an fMRI study comparing behaviours and objects that are relevant or irrelevant to a situation. Brain response regions were found to differ for behavioural and for object irrelevance, while relevant behaviours and objects activated the same regions. It is not clear how judgments of objects and behaviours are related to judgment of information relevance, but this work shows there is specific brain activation for both relevant and irrelevant judgments and so it is plausible that the brain activity in information relevance judgments is detectable. This hypothesis received partial support from an EEG study conducted by Behneman et al. (2009), who showed that changes in the EEG (theta and alpha bands) can be used to distinguish sentences that are relevant or irrelevant to a given information need.

We explore the possibility of detecting brain activity related to information relevance judgments. We hypothesize that there are fundamental neural processes associated with relevance judgements and that these processes can be detected by fMRI. We have conducted an fMRI+eye-tracking experiment with N=10 participants. Due to technical difficulties eye-tracking data is available for N=4. The experimental design is shown in Figure 1. Each subject performed two types of tasks: 1) word search, and 2) information search. The 1st task involved locating a target word in a short text displayed on screen and was expected to require low-level orthographic processing. The 2nd task involved finding relevant factual information in news stories and was expected to require higher-level lexical/semantic processing. Each session included 21 pseudo-randomized trials of each task type, as well as a few training trials. Each trial in the 2nd task consisted of presentation of three news stories of varied relevance: irrelevant, topically relevant and relevant. The specific hypotheses were: H1. The two tasks involve activity in different brain regions. H2. Judging relevance of texts differing in degree of relevance involves activity in different brain regions.

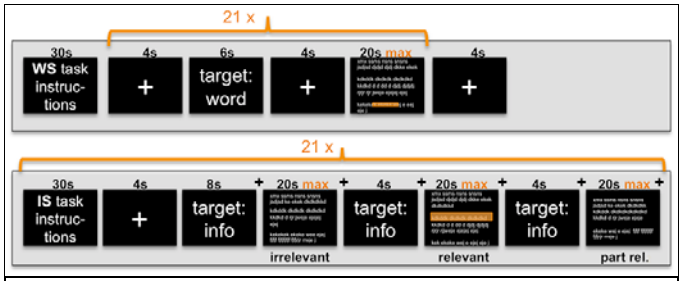

Figure 1. Experimental Design

We are carrying out fMRI data processing and analysis using FEAT (fMRI Expert Analysis Tool; part of FSL - FMRIB's Software Library: http://www.fmrib.ox.ac.uk/fsl) at the individual and at the aggregated (group) level on all participant data. Preliminary group analysis for N=4 shows distinct brain activations for texts stimuli of different degree of relevance.

At a theoretical level, our work contributes to better understanding of the multi-dimensional concept of information relevance. At an applied level, we believe that establishing distinctions in brain activity related to information search should lead to a better understanding of the search process and, as a consequence, to the design of better search engines.

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