New research shows how brain prepares to start searching

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A packed car park.

Many of us have steeled ourselves for those 'needle in a haystack' tasks of finding our vehicle in an airport car park, or scouring the supermarket shelves for a favourite brand.

A new scientific study has revealed that our understanding of how the human brain prepares to perform visual search tasks of varying difficulty may now need to be revised.

When people search for a specific object, they tend to hold in mind a visual representation of it, based on key attributes like shape, size or colour. Scientists call this 'advanced specification'. For example, we might search for a friend at a busy railway station by scanning the platform for someone who is very tall or who is wearing a green coat, or

a combination of these characteristics.

Researchers from the School of Psychology at the University of Lincoln, UK, set out to better explain how these abstract visual representations are formed. They used fMRI scanners to record neural activity when volunteers prepared to search for a target object: a coloured letter amid a screen of other coloured letters.

Their findings, published in the journal *Brain Research*, are the first to fully isolate the different areas of the human brain involved in this "prepare to search" function. Surprisingly, they show that the advanced frontal areas of the brain, usually key to advanced cognitive tasks, appear to take a backseat. Instead it is the basic back areas of the brain and the sub-cortical areas that do the work.

Dr Patrick Bourke from the University of Lincoln's School of Psychology, who led the study, said: "Up until now, when researchers have studied visual search tasks they have also found that frontal areas of the brain were active. This has been assumed to indicate a control system: an 'executive' that largely resides in the advanced front of the brain which sends signals to the simpler back of the brain, activating visual memories. Here, when we isolated the 'prepare' part of the task from the actual search and response phase we found that this activation in the front was no longer present."

This finding has important implications for understanding the fundamental brain processes involved. It was previously thought that the Intra-parietal region of the brain, which is linked to visual attention, was the central component of the supposed "front-back" control network, relaying useful information (such as a shape or colour bias) from frontal areas of the brain to the back, where simple visual representations of the object are held. If the frontal areas are not activated in the preparation phase, this cannot be the case.

The study also showed that the pattern of brain activation varied depending on the anticipated difficulty of the search task, even when the target object was the same. This indicates that rather than holding in mind a single representation of an object, a new target is constructed each time, depending on the nature of the task.

Dr Bourke added: "While consistent with previous brain imaging work on visual search, these results change the interpretations and assumptions that have been applied previously. Notably, they highlight a difference between studies of animals' brains and those of humans. Studies with monkeys convincingly show the front-back control system and we thought we understood how this worked. At the same time our findings are consistent with a growing body of brain imaging work in humans that also shows no frontal brain activation when short term memories are held."

More information: "Functional brain organization of preparatory attentional control in visual search" was published in the journal *Brain Research* (September 2013).

Provided by University of Lincoln