Searching in space and minds: New research suggests underlying link

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New research from Indiana University has found evidence that how we look for things, such as our car keys or umbrella, could be related to how we search for more abstract needs, such as words in memory or solutions to problems.

"Common underlying search mechanisms may exist that drive our behavior in many different domains," said IU cognitive scientist Peter Todd. "If how people search in space is similar to how they search in their minds, it's a very exciting prospect to try to find the deep, underlying roots of human behavior that may be common to varied domains."

Lead author Thomas Hills worked with Todd and fellow IU cognitive scientist Robert Goldstone in designing experiments to explore the search processes their study participants used in both spatial and abstract settings. The studies revolved around two search modes -- exploitation, where seekers stay with a place or task until they have gotten appreciable benefit from it, and exploration, where seekers move quickly from one place or one task to another, looking for a new set of resources to exploit. They then examined whether an initial search, in this case for resources in space, primed the mode used in the subsequent, more abstract search.

"We asked the question -- are the same mechanisms that let simpler organisms search in space for food related to how we search for things in our mind, for concepts or ideas," Todd said. "Our conclusion is that they

seem to be linked at some level, which is what our priming experiment suggests."

Some people might be more inclined to one search mode or the other, having a lesser ability to focus on a given task or difficulty letting go of an idea. An extreme form of the exploratory cognitive style would be someone with attention deficit hyperactivity disorder. An extreme form of the exploitive cognitive style would be someone with obsessive compulsive disorder.

These new findings, published in the latest issue of "*Psychological Science*," have possible implications related to other recent work on brain chemistry and cognitive disorders. Exploratory foraging -- actual or abstract -- appears to be linked to decreases in the brain chemical dopamine. Many problems related to attention -- including ADHD, drug addiction, some forms of autism and schizophrenia -- have been linked to such a dopamine deficit. The authors suggest that computer foraging, such as that used for their experiments, could reveal individual differences in underlying cognitive search style, and could even be used to manipulate that style. If that were possible, it could perhaps lead to therapies for such cognitive disorders.

Modern tools -- a computerized search game and board game -- used to examine ancient cognitive search processes

The scientists had a group of volunteers use icons to "forage" in a computerized world, moving around until they stumbled upon a hidden supply of resources (akin to food or water), then deciding if and when to move on, and in which direction. The scientists tracked their movements.

The volunteers explored two very different worlds. Some foraged in a "clumpy" world, which had fewer but richer supplies of resources.

Others explored a "diffuse" environment, which had many more, but much smaller, supplies. The idea was to "prime" the optimal foraging strategy for each world. Those in a diffuse world would in theory do better giving up on any one spot quickly and moving on, and navigating to avoid any retracing. Those in a clumpy world would do better to stay put in one area for an extended period, exploiting the rich lodes of resources before returning to the exploratory mode.

The volunteers then participated in a more abstract, intellectual search task -- a computerized game akin to Scrabble. They received a set of letters and had to search their memory for as many words as they could make with those letters. As with the board game, they could also choose to trade in all their letters for a new set whenever they wanted to.

The researchers found that the human brain appears capable of using exploration or exploitation search modes depending on the demands of the task, but it also has a tendency through "priming" to continue searching in the same way even if in a different domain, such as when switching from a spatial to an abstract task.

They also found that individuals were consistent in their cognitive style -- the most persevering foragers for resources in space were also the most persevering Scrabble players. Everybody should be able to switch back and forth, Todd said, but the people who have a tendency to use one mode more in one task have a similar tendency to use that mode more in other tasks.

Source: Indiana University

underlying-link.html