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Been there, done that: Brain mechanism predicts ability to generalize

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A new study reveals how the brain can connect discrete but overlapping experiences to provide a rich integrated history that extends far beyond individually experienced events and may help to direct future choices. The research, published by Cell Press in the October 23rd issue of the journal *Neuron,* also explains why some people are good at generalizing from past experience, while others are not.

Decisions are often guided by drawing on past experiences, perhaps by generalizing across discrete events that overlap in content. However, how such experiences are integrated into a unified representation is not clear, and fundamental questions remain regarding potential underlying brain mechanisms. It is likely that such mechanisms involve the hippocampus, a brain structure closely linked with learning and memory. The midbrain may also play a role, as its projections modulate activity in the hippocampus, and activity in both regions has been shown to facilitate encoding of individual episodes.

Dr. Daphna Shohamy from the Department of Psychology at Columbia University was interested in examining how past experiences might be integrated within the brain to create generalizations that guide future decisions. "We hypothesized that generalization stems from integrative encoding that occurs while experiencing events that partially overlap with previously encoded events and that such integrative encoding depends on both the hippocampus and midbrain dopamine regions. Further, we anticipated that greater hippocampal-midbrain engagement during integrative encoding enables rapid behavioral generalization in

the future," offers Dr. Shohamy.

Dr. Shohamy and her collaborator, Dr. Anthony Wagner from the Department of Psychology at Stanford University, used functional magnetic resonance imaging to study participants engaged in an associative learning and generalization task. They found that activity in the hippocampus and midbrain during learning predicted generalization and observed a cooperative interaction between the hippocampus and the midbrain during integrative encoding.

"By forming a thread that connects otherwise separate experiences, integrative encoding permits organisms to generalize across multiple past experience to guide choices in the present," explains Dr. Shohamy. "In people who generalize successfully, the brain is constantly building links across separate events, creating an integrated memory of life's episodes. For others, although the brain may accurately remember each past event, this integration does not occur, so that when confronted with a new situation, they are unable to flexibly apply what they learned in the past."

Source: Cell Press