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Memory Integration

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The aim of this thesis was to characterize the neural mechanisms underlying memory integration. This chapter summarizes the findings presented in this thesis, and the final chapter contains an in-depth discussion thereof.

In **chapter 2,** we studied the neural underpinnings of regularity extraction across hippocampus-dependent episodic memories. The results of the experiment showed, first of all, that subjects were able to pick up (parts of) the complex regularity structure. At the brain level, we found higher connectivity between the hippocampus and the mPFC for the retrieval of items that were congruent to the regularity structure than for the items that were incongruent to it. Moreover, we also found increased cortico-cortical connectivity, a key feature of system-level consolidation, for the items that were congruent as compared with incongruent to the regularity structure. Finally, across a period of 48 hrs, there was less memory decay of congruent items than incongruent items. All in all, this experiment showed that our brain is highly capable of picking up complex regularity structures, which may become consolidated into stable, neocortical memory representations.

In a next experiment, presented in **chapter 3**, we characterized the influence of time and sleep on the transformation from episodic to semantic memory, considering both regularity extraction and the possible loss of episodic details. First of all, we found that regularity knowledge evolved in the first few hours post-encoding, as evidenced by an increase in generalization accuracy from immediately following encoding, to 4 hrs later. Whereas sleep and wakefulness did not differentially contribute to this increase, the amount of time spent in SWS did correlate with generalization accuracy. Interestingly, the extraction of regularities across episodic memories appeared to come at a price. We found that the memories for items that were congruent to the regularity structure contained less episodic details than the items that were incongruent to it. We speculated that this effect resulted from encoding differences between items congruent and incongruent to the regularity structure as the difference in episodic memory availability already existed immediately following encoding, and did not further evolve across the first 4 hrs post-encoding.

In **chapter 4** we shifted our focus from studying regularity extraction, to investigating how a previously formed regularity structure, or schema, impacts new memory formation. In particular, this study was designed to test whether the storage of schema-congruent items is impaired when memory of these items serves no direct goal. Subjects studied items that were either congruent or incongruent to a schema, and after a short interval, their episodic memory for these items was tested. At the behavioral level, we found that episodic memory accuracy was substantially higher for items that were incongruent, as compared with congruent, to the schema. At the brain level, we studied the parietal old/new effect, thought to reflect the retrieval of a high quality memory trace. It was found that this ERP effect was more pronounced for incongruent, as compared with congruent items. Together, the behavioral and EEG results revealed that memory was inferior for schema-congruent items, leaving us to conclude that current goals have a strong impact on what is stored into memory.

Finally, in **chapter 5**, we used a very different experimental approach than used in **chapters 2, 3 and 4**, in order to study hippocampal network computations. We investigated the influence of acute emotional arousal, as well as negative emotional traits, on representational separation in the hippocampus. Results showed that acute emotional arousal increased representational separation in the hippocampus, whereas symptoms of affective pathology were instead related to a breakdown in representational separation. We speculated that such a breakdown predisposes to the formation of overgeneralized, intrusive memories, such as is seen in depression or anxiety-related disorders.