In the event of memory

General Summary

Episodic memory describes the human capacity for mental time travel and revising past experiences. Life is experienced in a continuous manner, yet when we remember past experience, we often think back to specific events: Our last vacation, the afternoon at that special bookstore in New York we have been wanting to visit. This chunking of continuous experience into events is thought to occur based on contextual boundaries or shifts in internal goals, for instance leaving the bookstore and stepping onto the busy streets of New York. These boundaries trigger hippocampal responses, which are relevant for later memory recall and are thought to reflect associative binding of information encountered during the event. Most research on episodic memory processing and event boundaries relies on static image stimuli, which do not reflect the complexity of everyday life experience. Only in recent years has there been a shift to study episodic memory in dynamic stimuli recreating naturalistic conditions, such as short movie clips. In this thesis we addressed open questions on behavioral and brain processes underlying event memory formation **(Part I)** and systems consolidation **(Part II)**. In **Chapter 2,** we probed the temporal specificity of event boundary processes and their susceptibility to interfering information, where we found that the brain is susceptible to incoming information within 2s after an event boundary, leading to decreased event memory. In **Chapter 3**, we explored how sampling of elements in an event through eye movements affects its later memory. Our data suggest that a higher number of fixations during the viewing of a movie clip increased the likelihood of its successful memory recall, both after 20 minutes and 24 hours. In **Chapter 4**, we investigated which brain regions support boundary processing and whether differences can be observed along the hippocampal anterior-to-posterior axis. We found that the body and tail, but not the head, of the hippocampus showed signal increases at event boundaries, and that the response was stronger for eventful compared to uneventful movies but failed to find differences between later remembered and forgotten clips.

Systems memory consolidation during sleep relies on reactivation of neuronal populations across several brain structures. Recent theories suggest that the thalamus and sleep spindles may play a role in coordinating these processes. In **Chapter 5**, we studied occurrence patterns of sleep spindles in the human thalamus and cortex. We found systematic mutual activity of sleep spindles in thalamocortical circuits, where distinct topographical patterns of spindle co-occurrence in the cortex could be observed, depending on the thalamic channels involved in a given spindle. Although memory was not tested, our observations in this chapter support notions on the coordinating role of the thalamus during systems consolidation through systematic spindle coordination in thalamocortical loops.

Conclusion

In this thesis, we report behavioral and brain processes underlying event memory formation. In Part I, we highlight the importance of using dynamic stimuli and longer retention intervals to study event memory in naturalistic conditions. Because our results partially conflict with existing literature, more research is needed to elucidate the role of the hippocampus for event memory processing. In Part II, we provide evidence for a basic assumption of thalamocortical coordination during sleep, but further research needs to be carried out to pinpoint whether this mechanism underlies systems consolidation.