In the event of memory

Appendix A: Impact Paragraph

When you think back to your last birthday, you may remember the people you spent the day with, the cake you ate, the surprise party that was thrown for you, or the way you tried to move throughout the day trying to forget about the fact that you were growing older. Whichever way you celebrated or didn't celebrate your birthday, chances are that you remember the events of this day and can tell them to another person if asked.

The human capacity of episodic memory makes it possible for us to mentally time travel back and revisit past experiences (Tulving, 2002). Episodic memory describes the memory for autobiographical events. A big part of what defines us as people is our past as seen through the lens of memory. Unlike other forms of learning, episodic memory is formed after single experiences of situations and does not require repetition of information (think of studying for a vocabulary test, for example, or learning to drive a bike). Although we don't consciously rehearse the information of what happened during our birthday, while we sleep, our brains reactivate information to manifest experience into plastic changes in the brain.

This thesis investigated how behavioral and neural processes during the experience of events, and the period immediately following those events, may lead to remembering or forgetting. To this end, we showed participants short movie clips in several conditions. In **Chapter 2**, we show that watching two clips in immediate succession decreases memory performance. This is in contrast to intact memory performance for clips that are shown in isoluation, or followed by a short time window before showing the next clip. Together, these results suggest that the period right after the end of an event is relevant for memory processing in the brain. In **Chapter 3**, we show that viewing behavior (i.e., where we look) during events predicts better memory performance. In **Chapter 4**, we describe the brain regions involved in encoding these clips. In the second part of the thesis and **Chapter 5**, we analyzed data from deep brain structures in the sleeping brain in patients with epilepsy. These data are rare due to their invasive nature, but they allowed us investigate how different brain networks may coordinate their activity. Although we did not test memory in this study, the results of this study are important for memory research, because storage of memory information relies on the interaction of different brain networks during sleep.

The main purpose of this thesis was fundamental research into human episodic memory processing. Fundamental research often paves the way for

more applied research settings, which tend to have a higher direct impact on society. Nonetheless, several ways in which the work of this thesis impacts the scientific field and society can be named.

Chapter 1 outlines difficulties of recording data from deep structures in the human brain, particularly time-resolved data which cannot yet be captured with non-invasive neuroimaging techniques. The in-depth study of these brain regions would hardly be possible without multidisciplinary collaborations. This PhD project was made possible by the effort of two faculties, including several departments. **Chapter 5** illustrates how the collaboration between medical doctors and neuroscientists leads to production of knowledge that would otherwise not be gained. The outcome of this work has been published in two papers (Bernhard et al., 2022; Jacobs et al., 2022).

Chapter 2 to **4** used the same stimulus material to study behavioral and brain processes related to encoding and early consolidation stages of episodic memory, using dynamic stimuli such as movie clips. **Chapter 2** illustrates that irrelevant information presented right after a movie clip makes it more likely that this clip will be forgotten later on. This observation may be particularly relevant for the way information is presented on social media platforms nowadays. On apps like TikTok or Instagram, it is not uncommon to have short video clips quickly follow each other. The results of our study highlight how the speed at which information is presented can be problematic for memory retention of content.

The scientific field in general, and cognitive neuroscience in particular, suffers from a replication crisis, where results are not stable across studies. This may stem from the complexity of the human brain and human behavior that we study, but also small study populations (Button et al., 2013), variability in hypothesis definition, analysis workflows (Botvinik-Nezer et al., 2020), and a bias for publishing hypothesis-confirming results. Two studies in this thesis (**Chapter 2** and **Chapter 4**) were conducted with the goal of extending previously published results to new experimental conditions (**Chapter 2**) and advanced neuroimaging techniques (**Chapter 4**). In **Chapter 4**, we did not exactly replicate the results of previous studies, putting into question whether observations of the involvement of the hippocampus in event boundary processing are robust across studies. Overall, this thesis thus contributes to replication of neuroscientific research and to probing robustness of results across analysis techniques and experimental conditions.

Lastly, I want to outline my contributions as a scientist to society outside of the specific work of this thesis. At a broader level, I believe science is a dialogue, and should be handled as such. Without proper communication, the scientific

endeavor is nothing more than the indulgence of curiosity. Unfortunately, limited funding resources and a too-strong focus on citation metrics lead to competition and, in consequence, to strategic decisions of not sharing data or code. But the scientific dialogue is not limited to sharing knowledge with other scientists, it describes a broad spectrum of actions that can be undertaken for dissemination of knowledge. Throughout my PhD, I have undertaken several steps to share the outcomes of my studies. Some were more conventional, like discussions on academic twitter, presentations at conferences of for undergraduate students. But I also believe that it is necessary to make science more approachable for the general public, especially to counteract developments of scientific distrust and to empower women and marginalized groups in STEM fields. To do so, I have shared insights into life as a graduate student on my otherwise social media accounts, assembled book recommendations about women in STEM on my book-related Instagram account, and am currently working on a novel set in an academic context.

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