This festschrift issue of *Hippocampus* recognizes Lynn Nadel’s long career of outstanding theoretical and empirical contributions to the fields of psychology, neuroscience and cognitive science. It follows a symposium in his honor held at the University of Arizona, December 7–8, 2017, attended by many of the authors of the following articles. In this introductory article, we review Professor Nadel’s training, the university positions he held, and briefly discuss some of his central contributions.
O'Keefe, in which they outlined a theory of hippocampal function. This book, *The hippocampus as a cognitive map* (O'Keefe & Nadel, 1978), is both a citation classic and a formidable theory, even today. This conceptual framework was pivotal in bringing the very disparate human and animal literatures together in predicting how a spatial mapping system would be critical for memory processes. Nadel went on to show with a number of his colleagues in studies with rats that the ability to learn and remember places develops at a different rate than other forms of learning and clearly is affected during the normal process of aging (Barnes, Nadel, & Honig, 1980; Nadel & Willner, 1989). In addition, the cognitive map theory was based on the fundamental idea that there must be several independent memory systems. In fact, Nadel and O'Keefe (1974) provided one of the first statements of the "multiple memory system" idea, which is now dogma in the field of psychology.

The next important step in the evolution of the cognitive map idea was the hypothesis that part of the role of the hippocampus in spatial mapping involved the representation of "context" (Nadel & Willner, 1980). The special role of the hippocampus in mediating context effects has now been generally accepted and subsumed into many theoretical accounts of hippocampal function. The germ of this idea, and its durability, resulted in predictions for an exciting experiment regarding the role of spatial context in memory reconsolidation which was conducted many years later (see below).

Nadel also developed a theory of memory consolidation with Morris Moscovitch—Multiple Trace Theory (Nadel & Moscovitch, 1997)—that puts a new twist on the "classical idea" of consolidation (the "old conceptualization" was initially suggested by Squire, Cohen, & Nadel, 1984). The new idea suggests that the hippocampus plays a permanent role in episodic memory but only a temporary role in semantic memory. Again, just as with both the cognitive map and context ideas, there has been active debate in the field regarding the details of the theory. Nadel's ideas often turn from "controversial to consensus:" and emerging data suggest this may be the case for his ideas regarding memory consolidation. Some of the strongest data in favor of this concept have come from his own work on human memory including collaborations using neuroimaging methodologies to guide an understanding of what happens in the brain as memories age (Ryan et al., 2001). In collaboration with Gómez and Bootzin, Nadel has shown that toddler's naps affect what is remembered about an artificial grammar to which they had been exposed some hours before (Gómez, Bootzin, & Nadel, 2006). These data point to the importance of such sleep states in memory consolidation, even during development.

Nadel's ideas about context and consolidation recently led to a series of experiments involving the concept of "reconsolidation". This idea was first generated from experiments involving animals: A stable memory can be made vulnerable when reactivated and must be reconsolidated in order to survive. Nadel and his colleagues developed the first paradigm for studying reconsolidation in human episodic memory (Hupbach, Gómez, Nadel, & Hardt, 2007). They showed that reactivation induces updating of a previously acquired memory, eliminating the possibility that this effect results from either retroactive interference or source memory confusion. In further work, Hupbach, Hardt, Gomez, and Nadel (2008) went on to show that the original training context is the critical component in the reactivation procedure that confers this vulnerability to a memory. This finding links back to Nadel's ideas about the hippocampus and context. This recent study highlights the importance of Nadel's past findings, and his ability to sustain the output of high impact science throughout his career.

In other recent work, Nadel and Peterson (2013) propose that the hippocampus is more than a core long-term memory structure. Instead, like other parts of the medial temporal lobe, it is part of an interactive posterior representational system spanning perceptual and memorial systems. In this view, perception and memory are seen as involving many, if not most, of the structures in the ventral representational stream, critically dependent on extensive feedforward and feedback processes.

In addition to contributing significantly to empirical and theoretical psychology, Nadel also thought about the underpinnings of genetic and clinical disorders. He suggested that stress has a selective effect on hippocampal function, and has implications for syndromes such as PTSD, phobias, panic disorder and agoraphobia. The original ideas linking stress and the hippocampus stem from a *Psychological Review* paper (Jacobs & Nadel, 1985) that has had a profound effect on the field. In other seminal work, he has suggested that at least some aspects of mental characteristics observed in Down syndrome result from improper development of the hippocampus. This idea, which he first suggested in 1986 (Nadel, 1986), has been accepted in the field, and, in fact, many animal models of Down syndrome target the hippocampus when devising ways to mimic the disorder (for more recent work, see Edgin et al., 2010). In recognition of his work on Down Syndrome, Lynn Nadel received the National Down Syndrome Society Award for Research (2005), the J. Mills Award for Exceptional Contribution to Research in Down Syndrome (2011), and the International Sisley-Jerome Lejeune Award (2013).

Professor Nadel's contributions to psychology have been recognized by other awards including the Grawemeyer Psychology Prize (2006; shared with John O'Keefe), the Lifetime Achievement Award from the Society of Experimental Psychologists (2016), the Gold Medal Award for Life Achievement in the Science of Psychology, from the American Psychological Foundation (2017), the William James Award from the Association for Psychological Societies (2019), and an Honorary Membership in the European Brain and Behavior Society (2017).

This brief review is not exhaustive, but rather intended to give a flavor of Professor Nadel's outstandingly productive, innovative and sustained career as a scholar, scientist, collaborator, and teacher. Nadel's rigorous and creative thinking, combined with his good humor and generous spirit, have long inspired his students and colleagues. He continually encourages all of us to ask bold questions and to keep the big picture in mind. The papers in this volume report research examining questions motivated by Lynn Nadel's theoretical or empirical work, thereby continuing dialogues he started.
REFERENCES


