VISUALIZING TIME

PHILOSOPHY

Markosian, N. (2002, November 25). Time. In *The Stanford Encyclopedia of Philosophy (Fall 2011 Edition)*. Retrieved from http://plato.stanford.edu/entries/time/

Le Poidevin, R. (2000, August 28). The Experience and Perception of Time. In *The Stanford Encyclopedia of Philosophy (Fall 2011 Edition)*. Retrieved from http://plato.stanford.edu/entries/time-experience/

PSYCHOLOGY

Block, R. A. (1990). Models of Psychological Time. In R. A. Block (Ed.), *Cognitive models of psychological time* (pp. 1–35). Hillsdale , NJ: Lawrence Erlbaum Associates.

Hancock, P. A., & Block, R. A. (2012). 125th Anniversary Articles The Psychology of Time : A View Backward and Forward. *American Journal of Psychology*, *125*(3), 267–274.

We selectively review the progress of research on the psychology of time during the past 125 American years, starting with the publication of the first English-language psychological journal, The Journal of Psychology. A number of important articles on the psychology of time appeared in this journal, including the widely cited early article by Nichols (1891). The psychology of time is a seminal topic of psychological science, and although it entered a phase of decline and even moribund neglect, the past several decades have seen a prominent renaissance of interest. This renewed vigor represents the rebirth of the recognition of the centrality of the psychology of time in human cognition and behavior. Our selective overview highlights a number of strands of progress and how they have helped lead to the present, in which the cognitive neuroscience of time and timing in the brain is one of the most fervent and fertile modern areas of brain research. We also discuss some remaining challenges and potential lines of progress.

Wittmann, M., & van Wassenhove, V. (2009). The experience of time: neural mechanisms and the interplay of emotion, cognition and embodiment. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences*, *364*(1525), 1809–13. doi:10.1098/rstb.2009.0025

Time research has been a neglected topic in the cognitive neurosciences of the last decades: how do humans perceive time? How and where in the brain is time processed? This introductory paper provides an overview of the empirical and theoretical papers on the psychological and neural basis of time perception collected in this theme issue. Contributors from the fields of cognitive psychology, psychiatry, neurology and neuroanatomy tackle this complex question with a variety of techniques ranging from psychophysical and behavioural experiments to pharmacological interventions and functional neuroimaging. Several (and some new) models of how and where in the brain time is processed are presented in this unique collection of recent research that covers experienced time intervals from milliseconds to minutes. We hope this volume to be conducive in developing a better understanding of the sense of time as part of complex set of brain-body factors that include cognitive, emotional and body states.

Droit-Volet, S., & Gil, S. (2009). The time-emotion paradox. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences*, *364*(1525), 1943–53. doi:10.1098/rstb.2009.0013

The present manuscript discusses the time-emotion paradox in time psychology: although humans are able to accurately estimate time as if they possess a specific mechanism that allows them to measure time (i.e. an internal clock), their representations of time are easily distorted by the context. Indeed, our sense of time depends on intrinsic context, such as the emotional state, and on extrinsic context, such as the rhythm of others' activity. Existing studies on the relationships between emotion and time suggest that these contextual variations in subjective time do not result from the incorrect functioning of the internal clock but

rather from the excellent ability of the internal clock to adapt to events in one's environment. Finally, the fact that we live and move in time and that everything, every act, takes more or less time has often been neglected. Thus, there is no unique, homogeneous time but instead multiple experiences of time. Our subjective temporal distortions directly reflect the way our brain and body adapt to these multiple time scales.

COMPUTER SCIENCE

Aigner, W., Miksch, S., Schumann, H., & Tominski, C. (2011). Historical Background. In *Visualization of Time-Oriented Data* (pp. 15–45). London: Springer London. doi:10.1007/978-0-85729-079-3

Aigner, W., Miksch, S., Müller, W., Schumann, H., & Tominski, C. (2008). Visual methods for analyzing time-oriented data. *IEEE transactions on visualization and computer graphics*, *14*(1), 47–60. doi:10.1109/TVCG.2007.70415

Providing appropriate methods to facilitate the analysis of time-oriented data is a key issue in many application domains. In this paper, we focus on the unique role of the parameter time in the context of visually driven data analysis. We will discuss three major aspects - visualization, analysis, and the user. It will be illustrated that it is necessary to consider the characteristics of time when generating visual representations. For that purpose we take a look at different types of time and present visual examples. Integrating visual and analytical methods has become an increasingly important issue. Therefore, we present our experiences in temporal data abstraction, principal component analysis, and clustering of larger volumes of time-oriented data. The third main aspect we discuss is supporting user-centered visual analysis. We describe event-based visualization as a promising means to adapt the visualization pipeline to needs and tasks of users.