ERPs and Neural Oscillations during Volitional Suppression of Memory Retrieval

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Abstract

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hippocampal or MTL activity are also found during the suppression of NT items, as compared with T items (Butler & James, 2010; Depue et al., 2007; Anderson et al., 2004). Increased LPFC activity correlates with decreased hippocampal/MTL activity both within participants (over the time course of NT trials) and across participants, as well as correlating with increases in the ability to behaviorally suppress retrieval, suggesting the possibility that LPFC–hippocampal/MTL interactions leads to successful suppression (Depue & Banich, 2012; Depue, Burgess, Willcutt, Ruzic, & Banich, 2010; Depue et al., 2007). Furthermore, the strength of correlations between activity in the LPFC and hippocampal/MTL increase as repetition increases, suggesting that as cognitive control is repetitively

impedance amplifier (200 MΩ, Net Amps, Electrical Geodesics, Inc., Eugene, OR). The electrodes were adjusted until impedance measurements were less than 50 kΩ.

Electrophysiological Data Processing

A 60-Hz digital notch filter was applied to the continuous EEG recordings to remove electrical line noise before epoching the EEG from 1000 msec before to 1700 msec after each stimulus of the TNT phase. Trials were discarded from analysis if more than 20% of the channels were bad (average amplitude over 100 μV or voltage fluctuations of greater than 50 μV between adjacent samples). Individual bad channels were replaced on a trial-by-trial basis with a spherical spline algorithm (Srinivasan, Nunez, Tucker, Silberstein, & Cadusch, 1996). Eye blinks were corrected using an ICA-based approach implemented in the ERP PCA Toolkit (Dien, 2010). EEG was baseline-corrected with respect to the 1 sec prestimulus interval of each trial average referenced (Dien, 1998), corrected for the polar average reference effect (Junghöfer, Elbert, Tucker, & Braun, 1999). ERP and EEG analyses were

corrected p = .05, 200–600 msec, 3–8 Hz; Figure 4A–C). An analogous interaction between the NTR and pB trials, similarly indicated a reduction of theta power across frontal electrodes between the first and second half of the subsequently remembered trials (NTR2–NTR1) that was larger than the first versus second half difference for perceptual baseline trials (pB2–pB1; cluster corrected p

volitionally suppress memory retrieval, behavioral results revealed suppression of NT items below T and baseline items. ERP results indicated increased parietal effects for T, as compared with NT and pB trials consistent with the waveform and temporal window (500–800 msec) of the parietal old/new effect commonly observed in memory paradigms. Investigating EEG oscillatory analyses revealed increases in both alpha and theta power for NT as compared with T trials ac47om-

suppression as assessed by the TNT paradigm (Depue, 2012; Tomlinson, Huber, Rieth, & Davelaar, 2009; Hertel

Düzel, E., Vargha-Khadem, F., Heinze, H.-J., & Mishkin, M. (2001). Brain activity evidence for recognition without recollection after early hippocampal damage. Proceedings of the National Academy of Sciences, 98, 8101–8106.
Eichenbaum, H., Yonelinas, A. P., & Ranganath, C. (2007). The medial temporal lobe and recognition memory. Annual Review of Neuroscience, 30, 123–152.
Fell, J., & Axmacher, N. (2011). The role of phase synchronization in memory processes. Nature, 12, 105–118.
Freunberger, R., Werkle-Bergner, M., Griesmayr, B., Lindenberger, U., & Klimesch, W. (2011). Brain oscillatory correlates of working memory constraints. Brain Research, 1375, 93–102.
Geiselman, R. E., Bjork, R. A., & Fishman, D. L. (1983). Disrupted retrieval in directed forgetting: A link with posthypnotic amnesia. Journal of Experimental Psychology: General, 112, 58–72.
Hanslmayr, S., Leipold, P., Pastötter, B., & Bäuml, K.-H. (2009). Anticipatory signatures of voluntary memory suppression. The Journal of Neuroscience, 29, 2742–2747.
Herron, J. E., Henson, R. N., & Rugg, M. D. (2004). Probability effects on the neural correlates of retrieval success: An fMRI study. Neuroimage, 21, 302–310.
Hertel, P. T., & Calcaterra, G. (2005). Intentional forgetting benefits from thought substitution. Psychonomic Bulletin & Review, 12, 484–489.
Jacobs, J., Hwang, G., Curran, T., & Kahana, M. J. (2006). EEG oscillations and recognition memory: Theta correlates of memory retrieval and decision making. Neuroimage, 32, 978–987.
Junghöfer, M., Elbert, T., Tucker, D. M., & Braun, C. (1999). The polar average reference effect: A bias in estimating the head surface integral in EEG recording. Clinical Neurophysiology, 110, 1149–1155.
Kahana, M. J., Seelig, D., & Madsen, J. R. (2001). Theta returns. Current Opinion in Neurobiology, 11, 739–744.
Klimesch, W. (1999). EEG alpha and theta oscillations reflect cognitive and memory performance: A review and analysis. Brain Research Reviews, 29, 169–195.
Klimesch, W., Sauseng, P., & Hanslmayr, S. (2007). EEG alpha oscillations: The inhibition-timing hypothesis. Brain Research Reviews, 53, 63–88.
Klimesch, W., Schimke, H., Doppelmayr, M., Ripper, B., Schwaiger, J., & Pfurtscheller, G. (1996). Event-related desynchronization (ERD) and the Dm effect: Does alpha desynchronization during encoding predict later recall performance? International Journal of Psychophysiology, 24, 47–60.63

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