Attention Modulates the Phase of Alpha Band Activity Relative to External Stimulus in a Visual Attention Task

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Effects of attention on the amplitude and power of brain responses to sensory input have been extensively studied. Previous research has demonstrated that attention enhances steady-state brain responses to attended stimuli and suppresses unattended stimuli (e.g., Chen et al. PNAS, 100:3501-3506, 2003). Here we study the effect of attention on the timing and phase of the intrinsic alpha band activity in a visual attention task. 5 human participants were presented with an array of vertical bars flickering at 7.4Hz while their whole head neuro-magnetic signals (MEG) were recorded. In the test condition they were instructed to pay attention to the flickering bars and to detect width changes in the central bars with a key press as soon as possible. In the control condition they passively looked at the flickering bars without making any response. Steady state visual responses at the tagged frequency (7.4Hz) were significantly higher in attended condition, while power at intrinsic alpha band decreased, similar to previous studies. More interestingly, intrinsic brain activities in the alpha band (8-14Hz) were phase synchronized to the flickering stimulus in both the attended and control conditions, indicating that steady-state visual responses involve phase re-setting of the intrinsic alpha activity. In addition, phase distributions of the alpha activity relative to the flickering stimulus in the visual areas were significantly different between attended and control conditions. This result demonstrates that attention significantly modulates the phase synchrony between alpha band activity and the external visual input.

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References