The dynamics of attentional sampling during visual search revealed by Fourier analysis of periodic noise interference

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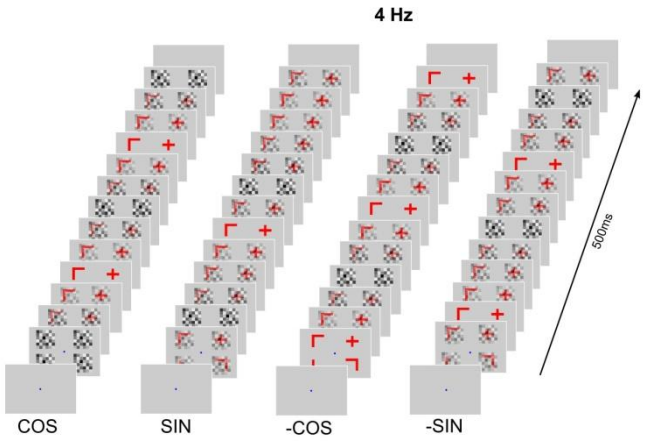
Visual search tasks have long been used to investigate the dynamics of attention deployment. Concerning difficult ("inefficient") search, two principal theories exist: visual attention could either focus sequentially on the stimuli, switching from one stimulus (or group of stimuli) to another, or process them all at the same time. The first hypothesis may imply a periodic sampling of the visual field by attention. We tested this hypothesis using periodic fluctuations of stimulus information during difficult search (color-orientation conjunction; n = 14) and easy ("pop-out") search (L vs. +; n = 14) tasks. Superimposed on each stimulus (500 ms), we applied dynamic visual noise which oscillated at a given frequency (2-20 Hz, 2 Hz steps) and phase (cosine, sine, -cosine and -sine). We estimated the dynamics of attentional sampling by computing an inverse Fourier transform on subjects' d-primes. In the difficult task, the sampling function was characterized by two peak frequencies: one low at 2 Hz, and one high, at 10 Hz (harmonic at 20 Hz). In the easy task, no periodicity in search processing has been observed. This study supports the idea of a periodic processing by attention during difficult search tasks.



Experimental design. Examples of four presentation conditions (cosine, sine, -cosine and -sine) at one example frequency (4 Hz) during the easy visual search task (+ vs. Ls). 10 different frequencies (2-20Hz in 2Hz steps) can be used. For all of these conditions, there was always the same amount of stimulus information and visual noise; only the temporal ordering of the display frames varied. A similar procedure was applied to a difficult visual search task (color-orientation conjunction task).