DEPARTMENT of ELECTRICAL & COMPUTER ENGINEERING
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Ph.D. Dissertation Defense Announcement

A STATISTICAL APPROACH TO VISUAL MASKING AND SPATIAL ATTENTION

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Abstract:

A stimulus (mask) reduces the visibility of another stimulus (target) when they are presented in close spatio-temporal vicinity of each other, a phenomenon called visual masking. Visual masking has been extensively studied to understand the dynamics of information processing in the visual system. Visual spatial attention is also known to modulate information processing and transfer within the visual system. Since both processes control the transfer of information from sensory memory to visual short-term memory (VSTM), a natural question is whether these processes interact or operate independently. Here, we modeled visual masking by using a statistical framework, and used this theoretical framework along with psychophysical experiments to determine whether and how masking and attention interact. In a psychophysical experiment, observers were asked to report the orientation of a target bar under three different masking paradigms. The distribution of response errors was modeled by using statistical mixture-models. Our results show that in all three types of masking, the reduction of a target's signal-to-noise ratio (SNR) was the primary process whereby masking occurred. We interpret these findings as the mask reducing the target's SNR *(i)* by suppressing or interrupting the signal of the target in para-/meta-contrast, *(ii)* by increasing noise in pattern masking by noise, and *(iii)* a combination of the two in pattern masking by structure. Recent evidence suggests that the studies that reported interactions between masking and attention suffered from ceiling and/or floor effects. We investigated interactions between metacontrast masking and attention by using an experimental design in which saturation effects were avoided. In these experiments, attention was controlled either by set-size or by spatial pre-cues. We examined attention-masking interactions based on two types of dependent-variables: *(i)* the mean absolute response-errors and *(ii)* the distribution of signed response-errors. Our results show that both the voluntary (endogenous) and reflexive (exogenous) mechanisms of attention affect observers' performance without interacting with masking. Statistical modeling of response errors suggests that attention and metacontrast masking exert their effects mainly through independent modulations of the guessing component of the mixture model. Taken together, our results suggest that the visual masking and attention operate independently.