Nonadditivity of stochastic and deterministic masks: suppression may contaminate estimates of equivalent noise

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References


Contrast matching experiments

Suppression should reduce the perceived contrast of a masked target. Noise with no suppression should not. Contrast matching experiments show that deterministic (grating) masks do have a suppressive effect (e.g. Meese & Hess, 2004). This is true of white noise, indicating a suppressive component. OD noise does not affect perceived contrast, so its masking effects must come entirely from the increased variance in the detection mechanism.

Double pass technique

Repeating a masking experiment twice, using the same samples of noise, permits estimation of the ratio of external internal noise. Entirely deterministic-masks do not contribute any external noise (not shown), but white noise masks cause observer responses to be more consistent. Yet they do this less effectively than OD noise (see Methods) that produces equivalent amounts of threshold elevation. So some, but not all of the masking effect of white noise can be attributed to stochastic factors.

Model predictions

• Intuitively, one might expect the distinct stochastic and deterministic masking effects to combine
• For a fixed contrast deterministic mask, and variable contrast noise, their combination could be: additive, superadditive, or super-additive, predicting converging noise masking functions nonadditive, predicting converging noise masking functions
• A noisy linear observer model would predict no effect of OD noise on a 3F target, yet previous studies (e.g. Meese & Hess, 2002) report substantial masking

Conclusions

• The 3F mask raised detection thresholds fourfold (12dB)
• The 0D noise produced a typical noise masking function
• Data imply equivalent internal noise of 0dB (no 3F mask) or 12dB (3F mask)
• Masking functions converge fully at high jitter levels

Results

• Double pass agreement was similar for the two OD noise conditions - with and without a 3F mask
• Suggests that the 3F mask does not induce internal noise, so its masking effect must be due to suppression
• Rules out induced noise model

Double pass results

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Stochastic and deterministic masks are nonadditive

• Masking from cross-channel components is due to suppression,
not induced internal noise
• 2D white noise will produce both types of masking, explaining why it increases double pass response consistency, reduces perceived target contrast and causes ‘twin’ masking (right)

Precise change in information in each condition

Twin masking


Footnotes


