Orientation uncertainty reveals different detection strategies in noise

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**Purpose**

- External noise paradigms are based on the assumption that adding external noise quantitatively affects performance but does not qualitatively affect the processing strategy.
- However, we recently found that crowding impaired contrast detection thresholds in spatiotemporally localized noise but not in spatiotemporally extended noise. (In absence of noise there is no effect of crowding on detection thresholds.)
- Given that crowding impairs recognition without affecting detection, these results suggest that detection in spatiotemporally localized noise was based on a shape recognition strategy (e.g. does the shape of the stimulus match the expected target?) rather than by a standard detection strategy assumed to operate in absence of noise (e.g. was anything presented?).
- If detection is based on a shape recognition strategy in spatiotemporally localized noise, then trial-to-trial variation in the target shape (e.g. orientation uncertainty) should considerably degrade performance.
- In the present study, we evaluated the impact of orientation uncertainty on contrast detection threshold in different spatiotemporal distributions of external noise.

**Method**

- Contrast detection thresholds were measured using a 2IFC paradigm.
- Target:
  - 2 cpd sine wave grating
  - 8 possible orientations: 0, 22.5, 45, 67.5, 90, 112.5, 135, 157.5°
  - Spatial window: 1 degree × 0.125 halftone fading
  - Temporal window: 35 msec
- Noise:
  - 32% contrast white noise
  - Spatial distribution:
    - Localized: matching spatial window of the target
    - Extended: 6 degrees × 0.25 halftone fading
    - Temporal distribution:
      - Localized: matching temporal window of the target
      - Extended: continuously displayed dynamic noise (exampled every 35 msec)
- High orientation certainty:
  - Orientation blocked from trial to trial for each stimulus
  - 8 orientations per noise condition (one per orientation)
- Low orientation certainty:
  - Orientation randomized from trial to trial
  - 8 orientations per noise condition

**Stimuli**

- **No noise**
- **High noise**

**Results**

- Orientation uncertainty has a greater impact in spatially and temporally localized noise.
- Paired T-tests revealed that the orientation-uncertainty effect in spatially and temporally localized noise was significantly greater than in each of the other noise conditions (p < .05).
- No significant difference was observed among the four other noise conditions (p > .05).

**Conclusions**

- In spatiotemporally localized noise, orientation uncertainty has a greater impact on contrast detection threshold than in absence of noise and in spatially and/or temporally extended noise.
- This supports the hypothesis that a shape recognition strategy is more sensitive in spatiotemporally localized noise than the standard detection strategy that is assumed to operate in the absence of noise.
- This suggests that the standard detection strategy operates by detecting a spatial or temporal energy transient, which can be masked by the energy transient of localized noise.

**References**