Neurocognitive Dysfunction in Schizophrenia

- Attention/Vigilance
- Immediate Memory
- Secondary Memory
- Verbal Fluency, Learning
- Spatial Working Memory
- Motor Reaction Time
- Processing Speed
- Executive Functions
- Visual-motor Skills
Early Visual Processing Deficits in Schizophrenia: Evidence for Sensory Dysfunction
Perceptual/Sensory Dysfunction in Schizophrenia: Visual System

- Abnormal Smooth Pursuit Eye Movements
- ↓ Amplitude of ssVEPs to magnocellular-biased stimuli, but not parvocellular-biased stimuli
- ↑ Sensitivity to Backward Masking
- Impaired Motion Perception
- Impaired Spatial Localization
- Impaired Detection of Simple Visual Stimuli
- Impaired Stereopsis (binocular depth perception)
- ↑ Visual Thresholds
Figure 1. Eye tracking patterns in normal and abnormal pursuit

Levy et al., 1993
Normal

(20 deg/s ramp)

Schizophrenic

Open loop

- eye position
- target position

0 250 Time (ms)

0 4 Position (deg)

Holzman et al., 1998
Sensory Dysfunction in Early Visual Processing

- Eye tracking dysfunction
  - ↓ Acceleration (open loop gain)/delayed initiation
  - Impaired Motion Perception - ↑ velocity discrimination thresholds
  - ↑ Velocity discrimination thresholds correlated with ↓ pursuit acceleration
Eye Acceleration (deg/s²)

Moving Target Velocity (deg/s)

- Schizophrenic (n=15)
- Normal Control (n=8)

Holzman et al., 1998
Sensory Dysfunction in *Early* Visual Processing

- Eye tracking dysfunction
  - ↓ Acceleration (open loop gain)/ delayed initiation
  - Impaired Motion Perception - ↑ velocity discrimination thresholds
  - ↑ Velocity discrimination thresholds correlated with ↓ pursuit acceleration
Sensory Dysfunction in *Early* Visual Processing

- Eye tracking dysfunction
  - ↓ Acceleration (open loop gain)/ delayed initiation
  - Impaired Motion Perception - ↑ velocity discrimination thresholds
  - ↑ Velocity Discrimination Threshold (↓ contrast sensitivity) correlated with ↓ pursuit acceleration
$r = 0.70; P < 0.01$

Chen et al., 1999c
Sensory Dysfunction in *Early* Visual Processing

- ↓ Amplitude of ssVEPs to magnocellular-biased stimuli -
  - but not to parvocellular-biased stimuli
**Magnocellular condition:** standing luminance contrast equals depth of modulation, so that stimuli appear and disappear

**Parvocellular condition:** luminance contrast is modulated around a standing contrast of 48%, i.e., contrast never falls below 16% and stimuli never disappear

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Signal-to-Noise Ratio

Depth of Modulation (percent of luminance modulation)

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**a** Significant interaction between group and stimulus type (magnocellular versus parvocellular) \( F=5.0, df=1, 43, p=0.03 \).

**b** Significant difference between groups \( t=2.32-2.64, df=43, p<0.05 \).

Butler et al, 2001
Sensory Dysfunction in *Early* Visual Processing

↓ Amplitude of ssVEPs to magnocellular-biased stimuli correlates with velocity discrimination thresholds

Not true for parvocellular-biased stimuli
Kim et al., 2006

The graphs illustrate the relationship between ssVEP amplitude (SNR) and motion discrimination threshold for two conditions: magnocellular and parvocellular.

- **Magnocellular condition**: The correlation coefficient is $r_s = -.76$, with a significance level of $p = .004$.

- **Parvocellular condition**: The correlation coefficient is $r_s = -.38$, with a significance level of $p = .2$.
Increased Sensitivity to Backward Masking --
Persistence of Masking Effect
Perceptual/Sensory Dysfunction in Schizophrenia: Magnocellular Input to Dorsal Stream

- ↑ Sensitivity to Backward Masking
- Impaired Motion Perception
- ↓ Acceleration (open loop gain)
- ↓ ssVEP Amplitude


