16.1 VISUAL SHAPE COMPLETION DEFICITS ARISING IN FIRST-EPISODE AND CHRONIC SCHIZOPHRENIA, BUT ARE LESS SEVERE IN BIPOLAR DISORDER: EVIDENCE FOR A NOVEL BEHAVIORAL BIOMARKER

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Background: Visual shape completion is a fundamental process that constructs contours and shapes on the basis of the geometric relations of spatially separated edge elements. Behavioral and electrophysiological studies indicate that people with chronic schizophrenia are poor at visual shape completion but at what point does the impairment emerge, how does it evolve over time, and how specific is it to schizophrenia spectrum disorders? Addressing these questions could validate the impairment as an illness biomarker and identify visual neurodegenerative changes that accompany illness onset and progression.

Methods: We report data from two separate studies—the first comparing chronic schizophrenia patients (SZ), healthy controls, and bipolar disorder patients (Study 1); the other comparing SZ, healthy controls, and first episode psychosis patients (FE; Study 2). In each case, subjects judged whether four sectored circles (pac-men) formed a fat or thin illusory square (illusory condition); or whether four downward-pointing pac-men were individually rotated left or right (fragmented condition). Task difficulty depended on pac-man rotational magnitude, with larger rotations making the response alternatives easier to distinguish. A Bayesian adaptive staircase determined threshold, which corresponded to the amount of rotation needed for 80% discrimination accuracy. Visual shape completion was quantified as the extent to which performance in the illusory condition exceeded that of the fragmented condition. Illusory contour salience was also manipulated: in Study 1, half the trials contained distractor lines, which disrupt illusory contour formation and thereby worsen illusory shape discrimination; in Study 2, half of the trials incorporated wire edge elements, which augment illusory contour salience and thereby improve illusory shape discrimination.

Results: For Study 1, visual shape completion was worse in SZ patients than in bipolar patients (p<.05) and controls (p<.001), and marginally worse in bipolar patients than in controls (p=.07). For Study 2, completion was worse in FEs and SZs than in controls (p<.01), but the patient groups were indistinguishable (p>.5). Patients’ visual shape completion deficits could not be explained in terms of age, motivation, or poor orientation tuning. The deficits did correlate with increased cognitive disorganization and worse premorbid functioning during early adolescence. A somewhat surprising result was that each patient group in each study responded normally to alterations in illusory contour salience, indicating that the groups could form but not appropriately use illusory contours to discriminate shape.

Conclusions: Poor visual shape completion furnishes a potential biomarker for schizophrenia: the deficit arises maximally by the first psychotic episode, is more pronounced than in bipolar disorder, and may be most clearly observed among those with cognitive disorganization and poor premorbid functioning during early adolescence.

16.2 CONTOUR PERCEPTION IN SCHIZOPHRENIA: LOCALIZATION AND TIMING OF ABERRANT VISUAL CORTICAL PROCESSES

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Background: Visual illusions and hallucinations in psychosis likely reflect deviant functions within the hierarchy of visual cortical regions. Recent investigations point to aberrant sensory cortical processes as a source of visual perceptual errors in psychotic disorders like schizophrenia.

Methods: To better understand the basis of errant visual perception in the disorder, we conducted two experiments. First, we combined magnetoencephalography (MEG) and functionally localized magnetic resonance imaging (MRI) data to compute cortical source signals for people with schizophrenia (PSZ) and healthy controls (HCs). Imaging data were acquired while participants detected a simple contour made up of five visual elements that were surrounded by a dense field of similar elements. In our
second experiment, we examined event-related potentials (ERPs) recorded during the same contour perception task in PSZ, HCs, as well as people with bipolar affective disorder (PBP) and first-degree biological relatives of PSZ (RelPSZ), which allowed us to examine the diagnostic specificity of perceptual abnormalities.

**Results:** Source signals revealed PSZ to exhibit diminished delta and theta frequency responses in visual cortex. HCs showed theta responses to the contour within visual areas V1 and V3 that were lateralized (contralateral to the visual field where the contour appeared), while PSZ failed to show such lateralization. HCs also had theta responses to the contour that were modulated by the perceptual context created by surrounding stimuli, while this theta modulation was absent in PSZ. Interestingly, PSZ who had stronger contextual modulation of theta in V1 tended to better discern the contours, and PSZ who more strongly modulated theta in V3 reported more unusual perceptual experiences in their daily lives. In the second experiment, contextual modulation of brain responses was absent in the early brain responses (P1 and N1 ERPs prior to 200 msec) for all groups. The P2 ERP response (240 msec), recorded over lateral occipital regions, was significantly modulated by perceptual context, but this modulation was weaker for both PSZ and RelPSZ. These similar aberrations suggest that genetic liability for schizophrenia is associated with diminished suppressive functions in visual cortex involved in visual context processing.

**Conclusions:** In sum, multimodal imaging and electrophysiological data provide evidence that initial registration of visual stimuli is specifically aberrant in schizophrenia. Diminished effects of perceptual context during contour detection may reflect genetic liability for schizophrenia and is apparent in biological relatives of individuals with this disorder. Additionally, low-frequency oscillations within visual cortex may reflect the pathophysiology of abnormal visual perception in schizophrenia.

### 16.3 ARE VISUAL MOTION PERCEPTION AND DETECTION OF ANIMACY CRITICAL TO HIGHER-ORDER SOCIAL COGNITIVE FUNCTION IN SCHIZOPHRENIA?

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**Background:** The observation that individuals with schizophrenia tend to misinterpret subtle social cues is often attributed to deficit in Theory of Mind (ToM). While ToM is commonly assessed using videos portraying interaction between actors, recent work in vision science shows that stimuli with no innate animate features can also convey similar social information through motion alone. These simplified stimuli are advantageous for experimental purposes and may provide further insights into perceptual mechanisms supporting social cognitive function. The Social Attribution Task-Multiple Choice (SAT-MC), based on the classic Hider and Simmel (1944) stimuli, tells a story using three geometric shapes moving about a centrally fixed figure, followed by questions about what the viewer observed. Although there are no explicit social cues, viewers typically detect actions suggestive of relationships between objects, their intentions, and emotions. This talk will present findings from three studies examining psychometric, functional, and neurophysiological aspects on SAT-MC performance in schizophrenia.

**Methods:** Study 1 examined psychometric properties of two forms of the SAT-MC in comparison to video-based social cognitive tests using human actors in 32 schizophrenia (SZ) and 30 substance use disorder (SUD) participants. Study 2 examined functional relationships of the SAT-MC and affect recognition (BLERT) performance across neurocognitive, metacognitive, ToM, and symptom domains in 72 adults with SZ. Study 3 is an in-progress investigation of neurophysiological mechanisms of social cognition using test versions adapted for EEG recording. Chronic SZ, clinical high-risk (CHR), and healthy age-matched community samples are being collected.

**Results:** SZ scored significantly lower than SUD on two versions of the SAT-MC, each classifying ~60% of SZ as impaired, compared with ~30% of SUD. The two SAT-MC forms demonstrated good test-retest and parallel form reliability, minimal practice effect, high internal consistency, similar patterns of correlation with social cognitive test performance, and compared favorably to social cognitive tests across psychometric features. When examining functional correlates of SAT-MC performance, impairment is found to co-occur with deficits in affect recognition in the majority of cases but relates uniquely to reductions in verbal memory and emotional intelligence measures. Finally, a preliminary analysis (n=8 SZ, n=2 SUD) of EEG collected during SAT-MC video presentation finds significant correlations (r=-66.72) between occipito-parietal gamma desynchronization and task performance. Additional analyses find task-related EEG during SAT to be predictive of affect recognition (BLERT) and ToM (TASIT) performance, with correlates including alpha desynchronization in frontal, occipital, and temporal regions, and synchronization of temporal theta and occipital gamma (all r > .5).

**Conclusions:** SAT-MC performance is found to be reliable using different stimuli, related to affect recognition and ToM in three independent samples, and shows high diagnostic specificity in classifying SZ against a SUD sample. Functional correlates also involve encoding and emotional intelligence abilities tested outside the visual modality. Analysis of neural oscillatory activity related SAT-MC performance to visual and attention processes, as well as engagement of a broader social cognitive network applied to affect recognition and ToM tasks. Impairment in visual motion processing appears integral to schizophrenia pathophysiology and a critical factor influencing social cognitive abilities attributed to higher-order ToM ability.

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### 16.4 VISUAL DISTURBANCES UNDERLIE ABNORMAL EYE GAZE PERCEPTION IN PSYCHOSIS: PSYCHOPHYSICAL AND EFFECTIVE CONNECTIVITY EVIDENCE

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**Background:** Deficits in social cognition are pervasive in schizophrenia (SZ) and strong predictors of poor functional outcomes. Understanding of the mechanisms underlying critical social cognitive dysfunctions in SZ will advance our understanding of the disorder and help design targeted treatment. In this presentation, we examine a basic building block of social cognition—eye gaze perception—in SZ and bipolar psychosis (BP). Given the frequent documentations of visual perceptual anomaly in SZ, we specifically evaluate the role of visual disturbances in altered gaze processing in psychosis. We used psychophysics to isolate distinctive cognitive processes involved in gaze perception (Study 1) and applied dynamic causal modeling (DCM) to fMRI data to illuminate aberrant brain dynamics responsible for altered gaze processing (Study 2).

**Methods:** In Study 1, 157 participants (47 SZ; 55 BP; and 55 healthy controls, HC) viewed faces with varying gaze directions and made two-forced choice eye contact judgments ("yes" or "no"). In each individual, eye contact endorsement was examined as a logistic function of gaze direction. The slope and absolute threshold of this perception curve were used to index, respectively, visual perceptual sensitivity and self-referential bias. Individual measures and group differences were estimated using hierarchical Bayesian modeling. Markov Chain Monte Carlo (MCMC) implemented in WinBUGS was used to sample from the joint posterior distribution to estimate posterior probabilities of the parameters. In Study 2, 27 SZ participants and 22 HC completed a gaze perception task during BOLD fMRI. They viewed faces with varying gaze directions and made two-forced choice