

Clues to the Cognitive and Perceptual Origins of Social Isolation and Psychosis in Schizophrenia

In this issue, two articles by three leading research groups provide intriguing evidence of the cognitive and perceptual impairments that lead to key difficulties in the way patients with schizophrenia experience their own emotions and perceive the emotions of others. Ultimately, these papers may help identify origins of the problematic thinking and behavior that comprise the syndrome of schizophrenia.

The processes by which humans report internal experiences are complex. When healthy people describe how they felt in the past or how they anticipate feeling in the future, they tend to err on the positive side, reporting more pleasure than they actually had at the time and anticipating more pleasure than they are likely to have. Anyone who treats or loves someone with schizophrenia knows that affected patients have fewer of these healthy biases; they tend to describe a less rose-colored picture, with fainter memories of pleasure and less expectation of pleasure in the future. In this issue, Strauss and Gold (1) present a thoughtful review of the concept of anhedonia in schizophrenia and make a strong argument that the concept, and in fact the term itself, requires updating. Patients with schizophrenia are clearly able to report current pleasure, and in fact they are similar to the rest of the population in this regard, so in the current moment they are not anhedonic at all. Their inability to report past pleasure and anticipate future pleasure suggests that they appear anhedonic to themselves and to other people not because of an incapacity to experience pleasure but because of their cognitive failures.

The article by Gold et al. (2) suggests that impairments in the ability to recognize the emotions of others, which have been reported repeatedly in people with schizophrenia, may be mediated by very basic auditory processing deficits, such as difficulties in matching tones of varying frequency (pitch). In this study, auditory tone matching performance predicted ability to detect happiness and anger in recorded voices when the emotional expressions were based on voice pitch, but not if they were based on voice intensity or loudness. These results suggest that auditory tone matching ability has an impact not on the more obvious emotional expressions, such as yelling louder when one is angry, but on the more subtle expressions of anger and happiness, such as understated joy, that enrich human interaction.

These two articles have immediate treatment implications. Cognitive-behavioral therapies that specifically target cognitive impairment and negative (or nonpositive) expectations have recently been found to improve symptoms and functional ability (3), and cognitive remediation programs that target a range of perceptual (4) and higher-order (5) cognitive abilities have demonstrated clinically meaningful efficacy (6). Yet profound deficits remain in these patients, and better treatments are needed. Programs that target the specific social deficits seen in schizophrenia are in development (7; see also <http://clinicaltrials.gov/ct2/show/NCT01422902>). The Gold et al. study (2) suggests that remediation programs targeting the components of auditory processing that most strongly convey emotional meaning may be the

most relevant for helping patients with schizophrenia. Given that some of the most important aspects of auditory emotion expression have not been comprehensively assessed in schizophrenia, more basic work needs to be done to help create the most effective interventions. Furthermore, treatments that target perception and cognition with a combination of pharmacological and behavioral interventions have tremendous promise, but given the complexity of the study design required to assess their efficacy, they have barely reached the exploratory stage.

Perhaps more importantly, the work reported here begins to elaborate the mechanisms by which people with schizophrenia struggle to understand their own emotions and the emotions of others, two simple activities that serve as fundamental components of healthy relationships: How do I feel? How do you feel? Our ability to answer these basic questions accurately underlies our capacity to enjoy ourselves and others, to have friends, to be liked, to experience love.

So what happens if I fail at understanding how I feel or how you feel? And what if my expectations for what will happen next between us are hampered by confusion and discouragement? How is this related to psychosis? It is natural to think that this state of confusion and discouragement is a function of years of psychotic symptoms, but it is likely the opposite. The inability to know how oneself and others feel is quite possibly the root of the problem in patients with psychosis and schizophrenia, lurking mildly beneath the surface and manifested as social isolation (8) and mild cognitive difficulty (9) long before hallucinations and delusions erupt into the everyday life of a psychotic patient and his or her family (8).

The most recent research reported here and elsewhere urges us to revisit the question, implied at least a century ago (10), of whether the inability to process socially relevant information is the core cause of schizophrenia. If a young person is unable to report to others about his own emotional state and anticipate reward, if he is unable to understand the subtleties of human interaction, whether the stifled temper in another's voice, the hint of a smile in the eyes of a friend, or the graceful suggestiveness of a seductive movement of the body, stepwise he becomes isolated from the aspects of who humans are when we are at our most worthy of being appreciated.

Impairments in learning-dependent predictive perception (11–14) in young people may lead to isolation and psychosis. The hierarchical model of temporal processing (15) suggests that previous evolutionary and individual experience shape the manner by which neural circuitry stores memories and provides context for predicting perception. In each moment, the process of learning about relationships, whether between percepts, between people, or between adjacent units of time, helps us predict what will happen next. We are dependent on this system for everything from survival to joy. When it does not function well, the resultant confusion and discouragement lead to a dampening of emotional and cognitive connections with others, and a more personal and idiosyncratic set of interpretations of the outside world begins to gain prominence. The Strauss and Gold data suggest that people with schizophrenia have a weakened tendency to be optimistic about future events. This may render them vulnerable to having their expectations about their experience of the external world overwhelmed by internally based biases. If I can't understand how you feel, I won't be able to predict what you will do, which may make being with you less enjoyable to me. If I can't understand how I feel or

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what in the world will make me happy, the path of least resistance may circle me back to a resting point of externally incorrect but internally rewarding thoughts and fantasies. As with all Hebbian models of healthy neuroplasticity (16), the more this path is engaged, the more solidified it will become. Odd interpretations well worn and untested develop into delusional beliefs; a system that rewards an internally directed focus enlivens thoughts to hallucinations.

It is unclear whether cognitive and perceptual impairments precede or follow the emotional and social difficulties of people who have schizophrenia or are destined to develop it. Work is under way to address this question empirically (17). It seems likely that the arrow of causality moves in both directions. Regardless, as a result of the efforts of scientists such as those whose work appears in this issue of the *Journal*, we are beginning to learn the complex feedback mechanisms between perceiving, thinking, and feeling in people with schizophrenia. This work not only helps provide important background for the development of novel treatments for schizophrenia, but it may someday lead to behavioral or pharmacological interventions that will prevent psychosis altogether.

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