

## Emotion, Motivation, and Reward Processing in Schizophrenia Spectrum Disorders: What We Know and Where We Need to Go

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Theorists and researchers on schizophrenia spectrum disorders have long recognized the central role that emotional processing may play in these illnesses since the times of Bleuler and Kraepelin.<sup>1,2</sup> For example, our current diagnostic criteria for schizophrenia include reference to disturbances in a number of different aspects of emotional processing, including the ability to display affect either facially or vocally, the ability to display emotions that are deemed appropriate to the current context, and the ability to experience or anticipate pleasure. Further, clinicians have long noted the importance of negative mood and depression in understanding function, course, and outcome in this illness. However, despite the centrality of various aspects of emotional processing in several theories of the development of schizophrenia,<sup>3–6</sup> there is a surprising dearth of empirical work examining emotion and motivation in schizophrenia, particularly when one considers the huge body of work on other aspects of the illness, such as cognition, hallucinations, and delusions. The need for more empirical data in this regard has recently been recognized in a number of initiatives, including an offshoot of the Measurement and Treatment Research To Improve Cognition in Schizophrenia initiative that has emphasized the importance of more empirical work on negative symptoms in schizophrenia,<sup>7,8</sup> which include abnormalities in various aspects of emotional and motivational processing.

A first question one might ask is why the relative dearth of empirical research on emotion and motivation in schizophrenia? I say relative not only to recognize the work of investigators who have delved into this realm but also to emphasize how little work has been done in an area that so many theories deem highly important to

understanding both development and outcome in schizophrenia. One clear reason for the relative lack of empirical research in this area has been the historical notion that emotion or motivation is somehow hard to study empirically, that it is “wishy-washy,” that it cannot be quantified, and that it is too individualistic or person specific to allow us to draw robust conclusions about processes that might apply to groups of individuals. The massive advances made in affective science and affective neuroscience in the past 20–30 years have helped to dispel these notions and have shown us exactly how we can quantify and empirically study various aspects of emotion and motivation processing, both at a psychological and a neurobiological level.<sup>9–11</sup> Further, there is an already large and growing literature on animal models of specific aspects of emotional processing (fear and salience processing), motivation, and reward function that can be brought to bear in trying to understand the neural bases of these processes.<sup>12–15</sup> Fortunately, for the field of schizophrenia research, a number of investigators are beginning to translate these methods, theories, and concepts into work on schizophrenia, as the reviews in this special issue will illustrate.

Another reason for the relative lack of work on emotion and motivation in schizophrenia is the fact that there are actually a number of different processes and mechanisms captured by concepts of emotion and motivation processing, many of which are relevant to understanding schizophrenia. As such, the challenge is not so easy as simply studying “emotion” or “motivation,” but rather to delineate the separable components of these constructs and to make progress in understanding which of these are intact and which are impaired in schizophrenia, what their causal relationships are to each other, and how they may be differentially manifested across the course of the illness or play a role in risk or development. Again, the review articles included in this special issue begin to highlight some of the important distinctions that need to be made among different facets of emotion and motivation processing in psychopathology. For example, the review articles by Kring et al and Philips et al raise important distinctions between (1) the outward display of affect through facial or vocal channels; (2) the experience of emotion in individuals at multiple levels (subjective,

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physiological, behavioral responses); (3) the perception or recognition of affective stimuli; (4) the ways in which emotional processing influences other cognitive or behavioral processes (as in the memory and emotion work reviewed in Herbener et al); and (5) affective experience that may be more related to longstanding mood, trait, or personality function (such as the work reviewed in the Horan article). To further complicate things, we can examine these different aspects of emotional function in a variety of different ways, using behavioral measures, imaging measures, peripheral physiology measures, genetic influences, etc. In addition, these aspects of emotion processing may be conceptually distinct from, though interrelated with, constructs and processes related to motivation and reward processing. For example, the review and conceptual article by Gold et al begins to clarify the different constructs and processes involved in understanding reward processing, reward learning, and value computations in understanding schizophrenia and how these concepts are relevant to clarifying issues of motivation and life function in this illness. Taken together, this work illustrates that while the conceptual and methodological tools are now available to study the panoply of processes involved in emotion and motivational function, this area is every bit as rich and complex as the domain of “cold” cognitive processing that has generated so much work in schizophrenia over the past 50 years.

A second question one might ask is whether there is a sufficient body of evidence on any one of these constructs to begin to provide guidance as to what components of emotion and motivation are intact vs impairs in schizophrenia. I think the reviews included in this special issue clarify that the answer is yes, at least in some areas. For example, the review by Kring and colleagues summarizes a growing literature on laboratory-based studies of emotion elicitation that have generated the rather surprising result that emotional responses to affective stimuli in laboratory settings among individuals with schizophrenia is surprisingly intact! At the same time, the review by Horan et al clarifies that studies of negative and positive affectivity in schizophrenia, more trait-like components of emotional experience, provide a different picture. In contrast to studies on emotional responses to specific stimuli, the work reviewed by Horan suggests that individuals with schizophrenia consistently report reduced positive affectivity and increased negative affectivity. Of note, negative affectivity is not the same as negative symptoms but instead refers to the tendency of an individual to report various components of dysphoria in their everyday lives. Further, the review by Philips et al suggests that at least some of the same changes in emotional processing are present in individuals at risk for the development of schizophrenia spectrum disorders. Such results need to be taken into account by any theory of the role of emotional processing deficits in the development and

course of schizophrenia. Further, these results highlight the need to distinguish between different facets of emotional and motivation processes and the need to understand how and why there may be dissociations among these processes in schizophrenia, such that some are more impaired than others. Although none of the review articles in this special issue cover emotion recognition in schizophrenia, there is a clear body of evidence that this is impaired in schizophrenia.<sup>16</sup> However, what is not clear is whether these impairments reflect deficits in the recognition of emotion per se or more general deficits in various aspects of visual and auditory processing that influence emotion recognition as well as the recognition of other stimulus features.<sup>16</sup>

A fourth question to ask is where do we need to go from here? Although the reviews included in this special issue highlight where bodies of research are starting to accumulate, they also point to the need for much more extensive research on a number of fronts. First, the reviews by Kring and Horan make it clear that there are dissociations among what components of emotional processing are impaired vs intact in schizophrenia that are difficult to accommodate under existing theories of emotional function in schizophrenia. In other words, how might we explain relatively intact emotional reactivity to affective stimuli in laboratory settings if individuals with schizophrenia self-report greater levels of “anhedonia” and negative affectivity in their daily lives or on questionnaires? Although some progress has been made on this front,<sup>17,18</sup> these empirical results illustrate that we need to understand what mechanisms drive trait-related aspects of emotional function and how and why these may or may not reflect emotional reactivity to specific stimuli that can elicit emotional responses. For example, it may be that self-reports of negative and positive affectivity reflect processes other than just emotional responses to specific events or stimuli, such as the frequency of rewarding or punishing events in one’s environment, personality-related variations in interpretive biases or emotional regulation, the influence of depressed mood, or other coping or cognitive skills that serve to alter everyday responses to both positive and negative events or the anticipation of such events. In addition, although individuals with schizophrenia seem to self-report intact emotional experiences in laboratory-based settings, they consistently report reduced experiences or anticipation of pleasure upon clinical interview (the basis upon which negative symptoms in schizophrenia are typically rated). Thus, there is clearly a dissociation between what individuals with schizophrenia seem to experience in the moment when affect-eliciting stimuli are present and what they can self-report in the absence of such stimuli in the immediate environment. Second, the review by Herbener highlights the need for more studies of the influence of emotion on other processes in schizophrenia. The Herbener review focuses on the influence of emotional

valence on episodic memory in schizophrenia and suggests that such influences may be reduced in schizophrenia, particularly over longer memory delay periods. However, the degree to which such alterations are valence specific (eg, positive vs negative stimuli) are not yet clear, nor the degree to which such alterations are specific to episodic memory vs other aspects of cognition (selective attention, working memory, etc). Third, the work by Gold et al and Murray et al point to exciting emergent research in the area of reward processing and decision making in schizophrenia, but the varying results across studies highlight the need for more work that will help us understand the integrity of these in schizophrenia and how such functions are related to concepts of hedonic capacity and emotional reactivity. Fourth, we still have little understanding how reward-related processes may relate to self-reports of anhedonia or negative affectivity or to emotional responses to affective stimuli or events. Fifth, we need a much clearer understanding of the neurobiological systems that supports each of these different components of emotional, reward, and motivational processing and how they interact. As noted above, the literature on human and animal affective neuroscience is being to shed light on these questions, but much more work remains to be done. Sixth, and perhaps most importantly, we still have relatively little understanding of how all these emotional and reward-related processes relate to concepts of intrinsic or extrinsic motivation or to the challenges in social, educational, and occupational function that many individuals with schizophrenia experience in their everyday lives. In many ways, this last question is the most critical one and is the impetus driving much of this research. In fact, the importance of addressing this question is nicely captured by the following quote:

“The important question is not, what will yield to man (*or woman*) a few scattered pleasures, but what will render his (*her*) life happy on the whole amount.” (Joseph Addison, 1672–1719, British Essayist)<sup>19</sup>

As this quote indicates, the goal of understanding these processes in schizophrenia is to determine what role they play in the development of this illness and how we might be able to better improve the quality of life for individuals with this debilitating disorder. We hope that the reviews included in this special issue help to point out potentially fruitful pathways of research that will bring us closer to this goal.

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