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## Temporal course of emotional startle modulation in schizophrenia patients

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### Abstract

The temporal course of startle reflex modulation to emotional pictures was investigated in 49 relatively asymptomatic schizophrenia outpatients and 46 normal controls. Participants viewed pleasant, neutral and unpleasant pictures, which were presented for 6 s and acoustic startle probes were delivered at five different times after picture onset. Replicating previous findings schizophrenia patients showed the same affective modulation of the startle reflex as healthy controls when probes were presented later during the picture-viewing period (3800 ms). For the early probe times (300 and 800 ms), affective pictures proved to be the effective prepulse stimuli resulting in a clear Prepulse inhibition (PPI) effect in both groups. In contrast to previous findings, the PPI of startle response was not stronger during processing emotional stimuli relative to neutral stimuli. For control subjects, blink reflexes were larger for unpleasant pictures compared with neutral and pleasant pictures, representing an early activation of motivational systems. Schizophrenia patients on the other hand, did not show this early affective modulation of the acoustic startle reflex.

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### 1. Introduction

Abnormalities in affect have long been viewed as a key feature of schizophrenia. Bleuler (1911) considered these emotional disturbances to be fundamental symptoms of schizophrenia while the more striking delusions and hallucinations were regarded as accessory symptoms. Within the past two decades this early distinction has gained

renewed interest in schizophrenia research under labels such as plus and minus or positive and negative symptoms (Crow, 1980; Andreasen, 1982; Strauss and Carpenter, 1974). While the positive syndrome is defined by florid symptoms such as hallucinations, delusions or disorganized thinking, the negative syndrome is characterized by deficits in cognitive, affective and social functions (Andreasen et al., 1995; Häfner and Maurer, 1997; Lindenmayer et al., 1995). Affective disturbances such as affective flattening and anhedonia in particular seem to have some prognostic utility. In a

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recent five-year longitudinal study, emotional disturbances proved to be the most stable and prominent symptoms in a large sample of schizophrenia patients (Bailer et al., 1996).

Traditionally the assessment of emotional disturbances is based on self-report measures (e.g. the physical anhedonia scale; Chapman et al., 1976) or clinical rating scales (e.g. scale for the assessment of negative symptoms, SANS; Andreasen, 1983). Although the reliability of these ratings has been improved, the behavioral sample upon which the ratings are based may not exclusively reflect affective disturbances. These ratings are typically obtained in a clinical interview and it is easy to inadvertently rate behaviors in this context that are more related to interpersonal style and personality than to emotional abnormalities (Dworkin, 1992; see Kring et al., 1993 for a more extensive critique).

Some studies investigated the emotional expression of schizophrenia patients by using the facial action coding system, electromyographic measures of facial muscle activity or analyzing vocal parameters and found generally reduced expressive behavior in these patients (Kring et al., 1994; Krause et al., 1989; Pitman et al., 1987; Schneider et al., 1990). Although emotional expression seems to be reduced in schizophrenia patients, self-reports of emotional experience did not differ from those of normal controls, suggesting that the reduction of emotional expression might be an isolated phenomenon of psychomotor poverty rather than an index of affective flattening (Berenbaum and Oltmanns, 1992; Kring et al., 1993; Kring and Neale, 1996). Recent evidence suggests that the acoustic startle response—a fast protective reflex to an unexpected intense stimulus with rapid onset—might provide a more direct measure of the patient's emotional state. Over several years of study it has been demonstrated consistently and reliably that the human startle eyeblink response is potentiated during viewing of unpleasant pictures and inhibited during viewing of pleasant contents (Bradley et al., 1990; Cook et al., 1992; Hamm and Vaitl, 1996; Vrana et al., 1988). This affective modulation of the startle reflex is highly robust and has been replicated also using odors (Ehrlichman et al., 1995), sounds (Bradley and

Lang, 2000) or film clips (Jansen and Frijda, 1994) as emotionally evocative stimuli. Moreover, it has been shown that affective startle modulation can be used very effectively to study emotional disturbances in the field of psychopathology research. Subjects with specific phobias show a cue-specific startle potentiation when exposed to pictures of feared objects (Hamm et al., 1997). In addition, affective modulation of startle may help to discriminate among different anxiety disorders (Grillon et al., 1994; Lang et al., 1998). Moreover, using the startle probe methodology it has been demonstrated that psychopaths with high emotional detachment show clear deficits in fear induced startle potentiation (Patrick et al., 1993; Patrick and Lang, 1999).

Finally, two studies have also investigated the affective modulation of the startle reflex in schizophrenia patients. In both of these studies the response patterns of schizophrenia patients, however, did not differ from those of their first-degree relatives and controls (Curtis et al., 1999; Schlenker et al., 1995). In these studies, the group of schizophrenia patients was further divided into groups based on ratings of affective flattening or anhedonia. Contrary to the expectations and predictions of Schlenker et al. (1995), patients with flat affect showed the typical affective modulation of the startle reflex, while those patients having no affective flattening exhibited a reduced potentiation of the startle response during viewing of unpleasant pictures (Schlenker et al., 1995). This unexpected response pattern, however, could not be replicated in the Curtis et al. (1999) study. These data suggest that affective startle modulation is not affected by schizophrenia. Thus, the emotional regulation on the level of simple protective reflexes seems to be unimpaired in schizophrenia patients.

On the other hand, there is clear evidence that the modulation of the startle eyeblink response by non-startling stimuli shortly preceding the startle-eliciting probe is impaired in schizophrenia patients. This so-called Prepulse inhibition (PPI) is a very robust and rather automatic phenomenon (for reviews see Anthony, 1985; Filion et al., 1998) and may reflect a sensory gating system, which operates to protect perceptual analysis of

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