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An analysis of categorical perception of facial emotion in schizophrenia

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Abstract

Background: Emotion perception deficits have been extensively documented in schizophrenia and are associated with poor social functioning. Yet fundamental questions about the nature and scope of these impairments remain unanswered from commonly used experimental tasks. An alternative categorical perception paradigm that focuses on distinguishing boundaries between emotions was used to evaluate whether schizophrenia patients demonstrate atypical patterns of categorical perception and a negativity bias in the identification of ambiguous facial expressions.
Method: 47 schizophrenia outpatients and 31 nonpsychiatric controls completed a forced-choice emotion identification task. Stimuli consisted of a series of digitized facial images that were morphed in 10% signal intensity increments along continua between pairs of emotions (happy–sad; fearful–happy; angry–fearful; angry–sad) and presented in a random order. For each emotion continuum, measures of the response slope and the location of the boundary shift point between emotions were calculated for each group.
Results: The schizophrenia group demonstrated significantly shallower response curves than controls across all emotion continua. Despite these generally less precise demarcations between emotions, patients did not significantly differ from controls in the location of the shift point between emotions on any of the continua.
Conclusions: Schizophrenia patients demonstrated impaired categorical perception of facial expressions with generally less sharp categorizations of ambiguous stimuli to one emotion category or another. However, patients did not demonstrate a negativity bias in their processing of ambiguous facial expressions. The emotional continuum paradigm can help to clarify the nature and boundaries of affect perception deficits in schizophrenia.

Keywords: Schizophrenia; Categorical perception; Facial emotion; Affect perception

1. Introduction

Research over the past two decades has established that individuals with schizophrenia generally are less accurate than nonpatient controls in their ability to

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identify and discriminate among emotional expressions in still photographs of faces (Mandal et al., 1998), voice tones (Kerr and Neale, 1993), videotaped monologues (Bryson et al., 1997), and videotaped social interactions (Bellack et al., 1996). These impairments are evident in first-episode patients (Edwards et al., 2001) and, among more chronically ill patients, are present during periods of clinical remission (Kohler et al., 2003) and relatively stable over time (Addington and Addington, 1998; Streit et al., 1997). Emotion perception deficits are not fully attributable to antipsychotic medications or their side effects (Kerr and Neale, 1993; Salem et al., 1996) and are not consistently associated with clinical symptoms (Edwards et al., 2002; Bozikas et al., 2004). Furthermore, these deficits appear to have considerable functional relevance, as worse affect perception is associated with lower levels of interpersonal, social, and work functioning in schizophrenia (Brekke et al., 2005; Green, 2001; Ihnen et al., 1998; Kee et al., 2003; Mueser et al., 1996; Penn et al., 1996, 1997; Poole et al., 2000).

Despite growing interest in this area, fundamental questions remain unanswered. It is not yet known if individuals with schizophrenia exhibit a bias towards misidentifying certain types of emotions more than others or if they demonstrate the typical pattern of categorical (rather than continuous) perception of emotion found in non-clinical samples (discussed further below). For facial affect perception, studies have considered whether there is an emotion-specific perceptual deficit. Several of these studies suggest that, in addition to an overall deficit in emotion recognition, patients may show a relatively larger impairment in the identification of unpleasant emotions, including fear, disgust, and sadness (e.g., Archer et al., 1994; Bellack et al., 1996; Edwards et al., 2001; Gaebel and Wolwer, 1992; Kohler et al., 2003; Phillips et al., 1999; Schneider et al., 1995). Along these lines, Kohler et al. (2003) conducted an analysis of errors involving misattribution of emotion to neutral facial displays on an emotion identification task. Compared to healthy controls, schizophrenia patients tended to over-attribute disgust and under-attribute happiness to neutral displays as compared to controls, suggesting that patients may over-identify certain unpleasant emotions. While these studies can address the question of whether patients have poorer accuracy on some emotions compared with others, they do not directly address the issues of whether patients show a *bias* for seeing certain emotions more than others.

One experimental paradigm that directly addresses these issues focuses on the *boundaries* between emotions, rather than accuracy of recognizing certain emotions, by presenting facial stimuli that vary along continua between "pure" emotions. In the emotional continuum paradigm, continua of facial images between pairs of prototype facial expressions of different emotions (e.g., 100% happy to 100% sad) are constructed using computer morphing techniques such that each adjacent face represents an equivalent (e.g., 10%) physical change. These stimuli are then used in identification or discrimination tasks to evaluate whether facial affect perception occurs in a categorical or continuous manner.

Research in healthy subjects demonstrates that within a series of facial expression stimuli differing by equal physical increments, the probability of identifying the expression as a particular emotion does not vary linearly across the series from one endpoint to the other (as would be expected if emotions are perceived continuously). That is, continuous perception of emotion would yield a flat response curve or a straight line, rising at equivalent levels across the facial emotion images. Instead, small physical differences in pairs of facial stimuli that straddle a subjective boundary between two emotion categories are identified much more accurately than the same size differences between faces within the same category (e.g., Bimler and Kirkland, 2001; Calder et al., 1996; de Gelder et al., 1997; Etcoff and Magee, 1992; Pollak and Kistler, 2002; Young et al., 1997). In other words, facial stimuli within an emotion category are perceived as more similar to each other than to facial stimuli belonging to a different category, even if the physical differences between them are equal. This categorical aspect of emotion perception is typically revealed on graphs as a sharp boundary near the midpoint of the continuum. Categorical perception of emotion is evident very early in development (e.g., Kotsoni et al., 2001), and it has been proposed that this process is an adaptive feature of perception that evolved to facilitate rapid and appropriate responding to cues in the social environment (e.g., Ekman and Davidson, 1994; Etcoff and Magee, 1992).

In addition to testing categorical versus continuous models of perception, the emotional continuum paradigm can be used to rigorously examine whether clinical groups demonstrate differential patterns and biases in the perceptual processing of pleasant and unpleasant facial expressions. For example, Pollak and Kistler (2002) found that children with histories of severe physical abuse demonstrated a selective pattern of abnormal emotion perception using continua spanning the categories of happiness, anger, sadness, and fear; the abused children significantly over-identified anger as