Emotional Valence and Reference Disturbance in Schizophrenia

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The authors examined the impact of emotional valence on reference disturbance in patients with schizophrenia and identified factors that moderate individual differences in this relationship. Thirty-nine patients with schizophrenia were given an interview that elicited speech samples in response to 10 neutral and 6 negatively valenced emotional questions. Speech samples were analyzed using the Communication Disturbances Index (N. M. Docherty, M. DeRosa, & N. C. Andreasen, 1996). Participants were also assessed with the Positive and Negative Symptom Scale (S. Kay, 1991) and a single-trial Stroop task (Stroop, 1935). Group analyses indicated that negative questions elicited more unclear references than neutral questions. Both the severity of disorganization symptoms and selective attention deficits predicted increased reference errors in response to emotional questions.

Previous research indicates that patients with schizophrenia exhibit deficits in both cognitive and emotional domains. However, few researchers have examined the relationship between cognitive and emotional disturbances in schizophrenia. An exception to this is work by Nancy Docherty and colleagues, who have examined the influence of emotional valence on language production in schizophrenia. Their work has demonstrated that patients produce more speech errors when discussing negative as compared with positive topics (Docherty, Evans, Sledge, Seibyl, & Krystal, 1994; Docherty, Hall, & Gordinier, 1998; Docherty & Hebert, 1997; Docherty, Sledge, & Wexler, 1994). However, whether patients with schizophrenia produce more speech errors when discussing negative as compared with neutral topics is not known. In addition, the clinical and cognitive factors that may influence affective reactivity are still unclear. Thus, the goals of this study were (a) to examine reference errors in response to negatively valenced as compared with neutral questions and (b) to identify clinical and cognitive factors that may moderate emotional influences on language production.

Docherty has coined the term *affective reactivity* to refer to the finding that patients with schizophrenia have more disturbed language talking about affectively negative topics than when discussing affectively positive topics. Her original work on this topic used both Andreasen's (1979) Thought, Language and Communication Scale and Halliday and Hasan's (1976) reference coding scheme. Docherty et al. recently developed the Communications Distur-

bances Index (CDI) as a potentially more sensitive measure of language dysfunction in schizophrenia (Docherty, DeRosa, & Andreasen, 1996). The CDI codes for *reference disturbances* in spoken speech, which are defined as words or phrases that make the meaning of the larger communication unclear. Using the instrument, Docherty has again found that patients produce more disturbed speech when discussing negative as compared with positive topics (Docherty et al., 1998; Docherty & Hebert, 1997).

Docherty's work has provided important and novel information about emotional influences on language in patients with schizophrenia. For the most part, the results of her studies have been interpreted to suggest that negative valence impairs language production in patients with schizophrenia. However, this previous research has not included speech samples from affectively neutral topics. Thus, it is not clear whether the difference in language function between positive and negative topics reflects (a) impaired language production when discussing negative topics or (b) improved language production when discussing positive topics. One way to help determine whether negative valence impairs language production among patients with schizophrenia would be to examine neutral as well as negative topics.

An additional interesting question raised by prior research is the source of individual differences in language affective reactivity among patients with schizophrenia. When groups of patients were examined as a whole, Docherty found increased reference errors in response to negative topics. However, some patients show a large degree of affective reactivity in their language, whereas others show very little. As such, identifying the factors that influence individual differences in affective reactivity may provide important clues to the mechanisms that lead to changes in language production as a function of emotional content. One such factor may be the severity of specific clinical symptoms. For example, Docherty found that language affective reactivity among patients with schizophrenia was positively correlated with hallucinations and delusions but that it was not associated with negative symptoms (Docherty & Hebert, 1997). In a more recent study, overall severity of reference disturbance was positively associated with global ratings of conceptual disorganization and formal thought disorder in patients with schizophrenia (Docherty et al., 1998).

However, this study did not examine affective reactivity in language. Thus, it is not clear whether the severity of disorganization or formal thought disorder predicts affective reactivity in language.

In addition to clinical symptoms, cognitive functioning may also moderate affective reactivity in the language of patients with schizophrenia. Some prior studies have found relationships between global measures of language production deficits and cognitive dysfunction in schizophrenia. For example, Docherty found that severity of overall reference disturbance is related to deficits in both working memory and selective attention (Docherty & Gordinier, 1999; Docherty, Hawkins, et al., 1996). Consistent with these findings, we have also found that conceptual disorganization symptoms (which include thought disorder) are associated with deficits in selective attention in schizophrenia, as measured by the Stroop task (Barch, Carter, Hachten, & Cohen, 1999; Barch, Carter, Perlstein, et al., 1999; Cohen, Barch, Carter, & Servan-Schreiber, 1999). More specifically, we found that the severity of disorganization symptoms was positively correlated with errors in the incongruent condition of the Stroop tasks and reaction time (RT) facilitation (congruent RT – neutral RT) but not with RT interference (incongruent RT – neutral RT). In prior work (Barch, Carter, Hachten, & Cohen, 1999; Barch, Carter, Perlstein, et al., 1999; Cohen et al., 1999), we have argued that this particular pattern of Stroop performance among patients with schizophrenia (i.e., increased incongruent errors and increased RT facilitation) reflects an inability to inhibit the influence of the word dimension, caused by a deficit in attending to task-relevant information. However, neither Docherty nor we have examined whether selective attention deficits are associated with affective reactivity in patients with schizophrenia. One hypothesis is that patients who have baseline selective attention deficits have even greater attentional disturbances when asked to discuss affectively valenced information that may elicit task-irrelevant information that needs to be ignored.

The primary goal of our study was to determine whether patients with schizophrenia displayed more reference errors when discussing affectively negative topics as compared with affectively neutral topics. Positive findings provide reason to conduct further studies to elucidate the precise mechanisms by which negative valence has an influence on language production. A second goal of our study was to examine the relationships among specific clinical symptoms, selective attention deficits, and individual differences in affective reactivity. We hypothesized that disorganization symptoms and potentially reality distortion symptoms (but not poverty symptoms) and selective attention deficits (as measured by the Stroop task) would be positively associated with both (a) baseline reference errors (i.e., during the neutral condition) and (b) an increase in reference errors when discussing negative as compared with neutral topics (i.e., affective reactivity).

Method

Participants

Thirty-nine inpatients at Mayview State Hospital participated in the study.[1] Diagnoses for patients were based on a semistructured interview for the Positive and Negative Symptom Scale (PANSS; Kay, 1991), a review of the patients' medical records, and consultation with the patients' treatment team. Of the 39 patients, 35 were diagnosed with schizophrenia and 4

with schizoaffective disorder. Patients were excluded for (a) substance abuse within the prior 6 months, (b) neurological illness or history of head trauma with loss of consciousness, (c) mental retardation (based on chart diagnoses), (d) English as a second language, (e) color blindness, or (f) poor visual acuity. See Table 1 for demographic and clinical information. Daily oral doses of antipsychotic medications were converted to chlorpromazine equivalents according to guidelines suggested by Davis, Janicak, Linden, Moloney, and Pavkovic (1983). Depot doses were converted to average daily dosages using the guidelines suggested by Baldessarini (1985). All patients signed informed consent forms in accordance with the University of Pittsburgh Medical School and Mayview State Hospital institutional review boards and were paid for their participation.

PANSS ratings were completed by one of two doctoral-level clinical psychologists. As in our prior work, we grouped symptoms into three factors (Liddle, 1987): Reality Distortion, Poverty Symptoms, and Disorganization. The following items were used for each scale: (a) delusions and hallucinations for Reality Distortion ($\alpha = .75$); (b) blunted affect, motor retardation, and lack of spontaneity for Poverty ($\alpha = .88$); and (c) conceptual disorganization, mannerisms and posturing, difficulty in abstract thinking, and poor attention for Disorganization ($\alpha = .83$). Twelve patients selected at random were rated by both psychologists (each of whom was blind to the other's ratings). Interrater reliability, measured using intraclass correlations (Shrout & Fleiss, 1979) with raters treated as random effects and the individual rater as the unit of reliability, was .96 for Reality Distortion, .90 for Poverty Symptoms, and .95 for Disorganization.

Procedure

Communication Disturbances

Speech samples. Each patient was administered a structured interview consisting of 16 open-ended questions. Ten questions were designed to elicit a neutral response, and 6 questions were designed to elicit a negative response. All interviews were audiotaped for later transcription. These 16 questions were chosen on the basis of norming data from two independent samples. The first sample consisted of 25 men and women (age range = 21 to 45 years) from Carnegie Melon and University of Pittsburgh (staff, graduate students, and faculty). Participants were given 50 questions and were asked to rate the degree to which each would elicit an affective response on a 5-point scale (1 = *would not elicit an affective response*, 5 = *would elicit a very strong affective response*). The 10 questions rated most likely to elicit an affective response (mean rating = 3.5) and the 10 questions rated least likely to elicit an affective response (mean rating = 1.9) were chosen. In the second norming study, a sample of 20 Washington University faculty, staff, and students (age range = 19–50 years) were asked to rate the 20 questions selected in the first norming study on their likelihood of eliciting positive or negative emotional responses. Participants used a 5-point scale (1 = *very positive,* 3 = *neither positive or negative,* 5 = *very negative*). Interrater reliability (.65) was estimated using an intraclass correlation coefficient with raters treated as a random effect and the mean rater as the unit of reliability. On the basis of these ratings, 6 of the 10 questions originally designated as likely to elicit an emotional response were rated as likely to elicit a negative response (see Appendix). These 6 questions were used in the analyses described below. The remaining 4 questions were not clearly rated as either positive or negative and were excluded from further analysis.

Language ratings. The interviews were transcribed by an undergraduate student, and two other students checked them for accuracy. The transcripts were then coded by five undergraduate students using the Communication Disorders Index (CDI; see Docherty, DeRosa, & Andreasen, 1996, for a detailed description of this measure). The dependent

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Table 1

Demographic and Clinical Characteristics of Patients With Schizophrenia

Characteristic	M	SD
Age (years)	38.7	9.5
Male gender (%)	64	
Education (years)	12.1	1.5
Length of current hospitalization (in days)	616.6	1,158.3
Age at first hospitalization (in years; $n = 34$)[a]	22.1	7.3
Length of illness (in years; $n = 34$)[a]	17.5	7.6
Chlorpromazine equivalents ($n = 38$)[a]	1372.2	1,780.6
% taking antiparkinsonians	40	
% taking antidepressants	22.5	
% taking mood stabilizers	47.5	
% taking benzodiazepines	32.5	
PANSS		
Reality Distortion	6.6	2.9
Poverty Symptoms	8.4	4.1
Disorganization	11.6	4.9
Total	77.0	19.1

Note. PANSS = Positive and Negative Symptom Scale.
[a] Demographic information for some participants was missing.

measures in all of the analyses presented below were the total CDI scores, which were the sum of the six CDI error types. Interrater reliability, calculated using an intraclass correlation coefficient with the raters treated as a random effect and the mean rater as the unit of reliability, was .94 for the total CDI score.

For each patient, total CDI scores for the neutral and negative conditions were calculated separately and then corrected for verbosity. Specifically, reference errors in each condition were calculated as the number of errors per 100 words of speech in that condition. This correction was applied to account for the possibility that those participants who spoke more simply had a greater opportunity to make reference errors. If so, a higher frequency of errors could be due to a greater amount of speech and not necessarily reflect more disturbed speech. The amount of speech generated by participants during the interview confirmed the need to correct for individual differences in verbosity. The average number of words per question was 41.3 ($SD = 34.5$) for the negative questions and 19.0 ($SD = 1.48$) for the neutral questions, a significant difference, $t(38) = 5.3$, $p < .001$.

Stroop Task

The stimuli were identical to those used by Carter, Robertson, and Nordahl (1992) and consisted of 96 trials: 24 (25%) congruent; 24 (25%) incongruent; and 48 (50%) neutral. Each trial consisted of a word printed in one of four colors: red, blue, green, or purple. The congruent stimuli consisted of one of the four color names presented in its own color. The incongruent stimuli consisted of each of the four color names presented in one of the three remaining colors. Neutral stimuli were one of four unrelated words (*dog*, *bear*, *tiger*, or *monkey*) printed in one of the four colors. The neutral words matched the color words in length and frequency and were selected from a single semantic category. Patients were told that their job was to read the color in which the word was printed as quickly and accurately as possible. Each word remained on the screen until the patient responded, or until 2,000 ms elapsed, and then was replaced by a fixation cross that lasted until the onset of the next stimulus. Regardless of RT, a new trial started 4 s after onset of the previous stimulus. Patients' verbal responses were tape-recorded for later coding of accuracy. We examined three measures from the Stroop task: RT facilitation (congruent RT – neutral RT), RT interference (incongruent RT – neutral RT), and errors in the incongruent condition.

Results

Affective Reactivity and Reference Disturbance

Our first goal in this study was to determine whether patients with schizophrenia displayed more reference errors when discussing negative as compared with neutral topics. Consistent with this hypothesis, a paired-samples *t* test indicated that patients displayed significantly more reference errors when answering the negative ($M = 3.3$, $SD = 3.2$) as compared with the neutral ($M = 1.9$, $SD = 1.4$) questions, $t(38) = 3.04$, $p < .005$. As described in the Method section, responses to negative questions were almost twice as long as responses to neutral questions. Although we corrected for verbosity when computing reference errors, one might still be concerned that the differences between negative and neutral questions reflect something about the degree of verbal elaboration rather than the emotional content of the question. To examine this question, we calculated correlations between length of response and the number of reference errors (corrected for verbosity). There was no significant relationship between response length and error frequency for negative questions ($r = -.08$, $p = .65$), but there was a significant relationship for neutral questions ($r = .58$, $p < .01$). Thus, we also conducted a repeated measures analysis of covariance (ANCOVA), with length of response as the covariate, frequency of reference errors as the dependent variable, and emotion (neutral, negative) as a within-subjects factors. Although the ANCOVA approach cannot take the place of controlling for length of response experimentally, a significant effect of emotion remained even after further controlling for length of response, $F(1, 37) = 9.40$, $p < .005$.

Reference Errors and Clinical Symptoms

We had hypothesized that disorganization symptoms would be selectively associated with reference errors during both the neutral and negative conditions. Consistent with this hypothesis (see Table 2), we found that disorganization symptoms were significantly positively correlated with reference errors in both the neutral and negative conditions. In contrast, neither reality distortion symptoms nor poverty symptoms were significantly correlated with reference errors in either the neutral or negative conditions. To determine whether reference errors in the neutral conditions were significantly more correlated with disorganization symptoms than the other symptoms, we used methods for comparing correlated correlation coefficients suggested by Meng, Rosenthal, and Rubin (1992). These analyses indicated that reference errors in the neutral condition were significantly more correlated with disorganization symptoms than either poverty symptoms ($Z = 2.19$, $p < .05$) or reality distortion symptoms ($Z = 1.74$, $p < .05$). However, there were only trends for reference errors in the negative condition to be significantly more correlated with disorganization symptoms than either poverty symptoms ($Z = 1.30$, $p < .10$) or reality distortion symptoms ($Z = 1.41$, $p < .10$).

We next examined whether the severity of disorganization symptoms moderated the influence of negative valence on the frequency of reference errors. We conducted a separate hierarchical regression analysis for each symptom variable. In these analyses, reference errors in the negative condition were the dependent variable, and reference errors in the neutral condition were entered

Table 2

Correlations Between Reference Errors, Clinical Symptoms, and Selective Attention Deficits

	Reference errors	
Variable	Neutral	Negative
Clinical symptom		
Conceptual Disorganization	.32*	.46**
Reality Distortion	.006	.21
Poverty Symptoms	−.12	.21
Stroop measure		
Stroop RT facilitation	.38*	.26
Stroop RT interference	−.09	−.21
Incongruent errors	.17	.40*

Note. RT = reaction time.
* $p < .05$. ** $p < .01$.

on the first step. The clinical symptom variable was then entered on the second step. These regressions indicated that disorganization symptoms accounted for a significant increase in variance in negative reference errors, $R^2_{change} = .13$, $F(2, 36) = 6.31$, $p < .05$, over and above the variance accounted for by neutral reference errors. However, poverty symptoms, $R^2_{change} = .07$, $F(2, 36) = 3.02$, $p = .09$, and reality distortion symptoms, $R^2_{change} = .04$, $F(2, 36) = 1.95$, p .17, did not significantly account for additional variance in negative reference errors.

Reference Errors and Selective Attention

We next examined our hypothesis that selective attention deficits in schizophrenia would be associated with reference errors in both the neutral and negative conditions.[2] Consistent with this hypothesis, we found that neutral reference errors were significantly positively correlated with Stroop RT facilitation. However, neutral reference errors were not significantly correlated with either Stroop RT or accuracy in the incongruent condition. We found it interesting that the reference errors in the negative condition were associated with decreased accuracy in the incongruent condition but that they were not significantly correlated with Stroop facilitation or interference. Analyses comparing the magnitudes of these correlations indicated that reference errors in the neutral condition were significantly more correlated with RT facilitation than with RT interference ($Z = 2.02$, $p < .05$) but that they were not more correlated with RT facilitation than incongruent errors ($Z = 1.02$, $p > .10$). In addition, reference errors in the negative condition were significantly more correlated with incongruent errors than with RT interference ($Z = 2.64$, $p < .05$), but they were not more correlated with incongruent errors than with RT facilitation ($Z = 0.69$, $p > .10$).

We next examined whether selective attention deficits moderated the influence of negative emotional valence on the frequency of reference errors. To do so, we again conducted a separate hierarchical regression analysis for each Stroop variable. Reference errors in the negative condition were the dependent variable, reference errors in the neutral condition were entered on Step 1, and the Stroop variable was entered on Step 2. These regressions indicated that accuracy in the incongruent condition accounted for a significant increase in variance in negative reference errors,

$R^2_{change} = .12$, $F(2, 36) = 5.87$, $p < .05$, over and above the variance accounted for by neutral errors. However, RT facilitation, $R^2_{change} = .01$, $F(2, 36) = 0.63$, p .40, and RT interference, $R^2_{change} = .03$, $F(2, 36) = 1.30$, p .25, did not account for a significant increase in variance in negative reference errors.

Discussion

The results of this study support the hypothesis that as a group, patients with schizophrenia displayed more disturbed reference in their language when discussing affectively negative versus neutral topics. In addition, the results provided evidence for clinical and cognitive factors that are associated with affective reactivity in language among patients with schizophrenia. In particular, we found that the severity of disorganization symptoms as well as disturbances in selective attention predicted a greater frequency of reference errors in response to negatively valenced questions.

Our finding of more frequent reference errors in response to negative as compared with neutral questions provides support for Docherty's prior interpretations of affective reactivity of language function in schizophrenia (Docherty, Evans, et al., 1994; Docherty et al., 1998; Docherty & Hebert, 1997; Docherty, Sledge, & Wexler, 1994). Specifically, the current results are consistent with the hypothesis that differences in language function between positive and negative topics among patients with schizophrenia reflect impaired language production when discussing negative topics. However, the current study did not address the question of whether there are differences in the frequency of reference errors when discussing positive versus neutral topics. As such, additional research is clearly needed that directly compares positive, negative, and neutral topics.

Further research is also needed to determine the specific mechanisms by which negative valence influences language production in schizophrenia. One possibility is that discussing negatively valenced topics increases general autonomic arousal levels and that increased arousal levels have a negative impact on the clarity of language production. This hypothesis is consistent with prior research showing that increased arousal can have a negative influence on at least some cognitive functions, such as selective attention (Hartley & Adams, 1974; Pallack, Pittman, Heller, & Munson, 1975). This hypothesis is also consistent with recent work by Docherty, Rhinewine, Nienow, and Cohen (2001), who found that patients with schizophrenia who demonstrate affective reactivity in language production also demonstrate increased startle response amplitudes. One way to examine this hypothesis in future research would be to include independent measures of different aspects of affective arousal, such as skin conductance and heart rate. The inclusion of such measures would allow us to directly evaluate patients' autonomic arousal levels when they are discussing negative and neutral topics and to determine whether increased arousal is associated with more disturbed language production.

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[2] This subset of patients displayed Stroop effects similar to the total sample, demonstrating significantly more Stroop facilitation (for patients, $M = 108$, $SD = 113$; for controls, $M = 53$, $SD = 51$) than controls, $F(1, 62) = 44.7$, $p < .001$, and significantly more errors (for patients, $M = 21\%$, $SD = 19\%$; for controls, $M = 5\%$, $SD = 8\%$) in the incongruent condition, $F(1, 62) = 18.2$, $p < .001$.

Consistent with previous research (Docherty, Evans, et al., 1994; Docherty & Hebert, 1997; Docherty, Sledge, & Wexler, 1994), we did not find a relationship between frequency of reference errors and poverty symptoms. However, unlike Docherty, we did not find an association between reference errors and reality distortion symptoms (i.e., hallucinations and delusions). It is possible that our inability to find such an association reflects a relatively low range of delusions and hallucinations in this sample of chronic inpatients. However, this seems unlikely given that 72% of our sample scored in the moderate or above range on either or both delusions and hallucinations. Instead, we found that disorganization symptoms were strongly and selectively associated with reference errors. This finding is not particularly surprising, because one of the components of disorganization is disturbed language. However, a more interesting finding was that disorganization symptoms predicted affective reactivity in reference errors. Taken together, these findings suggest that whatever underlying mechanism leads to disorganization symptoms and overall reference errors in patients with schizophrenia also may contribute to their language production being particularly vulnerable when responding to questions that elicit a negative affective response.

We also examined the relationship between reference errors and deficits in selective attention in schizophrenia. In our prior work, we found that deficits on the Stroop task (i.e., RT facilitation and incongruent errors) strongly correlated with disorganization symptoms (Barch, Carter, Hachten, & Cohen, 1999; Barch, Carter, Perlstein, et al., 1999; Cohen et al., 1999). Consistent with this prior research, our results indicated that Stroop RT facilitation was positively correlated with reference errors in the neutral condition and that incongruent errors were positively correlated with reference errors in the negative condition. In addition, we also found that patients with greater selective attention deficits were more likely to increase the frequency of reference errors in response to negative as compared with neutral questions. Thus, our current findings extend the findings of Barch et al. by demonstrating that the language of patients with selective attention deficits is more vulnerable to disturbance when responding to questions that elicit a negatively valenced response. In future work, it would be interesting to determine whether this relationship reflects a potential role for selective attention in regulating the influence of affective arousal on language and other cognitive functions. For example, it is possible that among patients with schizophrenia, disturbances in selective attention interfere with patients' ability to inhibit emotional aspects of stimuli if they are not task relevant, potentially interfering with their ability to attend to task-relevant information.

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Appendix

Interview Questions

Neutral

1. What did you have to eat today?
2. Do you listen to the radio? What do you like to listen to on the radio?
3. Do you watch or play sports? What kinds of sports do you like to watch or play?
4. What do you think about the weather?
5. What is your favorite season of the year? Why?
6. If you could chose anywhere in the world to live, where would it be? Why?
7. What is your favorite color? Why?
8. What did you watch on TV today?
9. What do you think about the military draft?
10. What are your favorite foods?

Negative

1. What kinds of things do you dislike about your family?
2. What is the most embarrassing thing that has ever happened to you?
3. When you are criticized, how do you react?
4. What do you consider the worst crime a person can commit? Why?
5. Tell me a story about something that made you mad.
6. What kinds of things do you worry about?