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Research Report

An exploratory study of the influence of conversation prosody on emotion and intention identification in schizophrenia

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ABSTRACT

Emotion perception deficits have been well documented in schizophrenia. However, very little is known about decoding of emotion cues in daily communication in this clinical group. The aim of the current study is to examine whether patients with schizophrenia experience difficulties in decoding other people's emotional cues, such as prosody, in daily conversations. Eighteen patients with schizophrenia and nineteen matched controls were administrated an emotion and intention identification task in a series of conversations with a prosody manipulation and a questionnaire that specifically captured subjective experiences of pleasure. Compared with the healthy controls, the patients with schizophrenia exhibited a chance-level performance in emotion identification in the presence of negative prosody. These findings suggest that patients with schizophrenia have a specific deficit in recognizing negative emotion in conversation.

1. Introduction

Decoding the emotional cues of others in communication is crucial for successful social interaction. Schizophrenia is associated with deficits in the ability to encode and decode emotion based upon facial affect (Bediou et al., 2007) or modulations of intonation (Leitman et al., 2007). More recently, more specific deficits in the auditory–sensory processes of patients with schizophrenia in prosody identification have been documented (Bach et al., 2009a; Bozikas et al., 2006; Hoekert et al., 2007) and their relationships with symptoms were investigated (Alpert et al., 2000; Shea et al., 2007). Neural mechanisms underlying the perception of dynamic audio–visual emotional cues might include superior temporal lobe in healthy populations (Robins et al., 2009). However, functional neuroimaging studies have

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found an increased right-lateralisation, especially in the right temporal lobe in patients with schizophrenia, as compared with the normal population when processing the emotional and nonemotional prosody (Bach et al., 2009b; Mitchell, 2007; Mitchell et al., 2001). With respect to developing proper intervention method in the future, identifying the neurocognitive process underlying the deficits of emotional identification in schizophrenia is important since the preliminary findings have suggested that such deficits, along with facial affect identification, contribute greatly to the impairment in social cognition and function experienced by many patients with schizophrenia (Brune et al., 2007; Hofer et al., 2009). Furthermore, facial emotion perception is one aspect of social cognition skills training (Horan et al., 2009) for schizophrenia. Investigation into emotion perception cued by prosody would hopefully shed light in developing another aspect of social cognition skills training.

However, previous studies only investigate the identification of simple tone-matching prosody rooted in some basic human emotions such as happy, anger, fear or sad rather than some 'subtle' emotion usually implicated by prosody. In daily communication, verbal expressions are conveyed with a rhythm that usually implies something more than the literal meaning of the words (Wakusawa et al., 2007). Wakusawa et al. suggested that intention judgment was carried out by the left medial prefrontal cortex (Wakusawa et al., 2007). The features of daily conversation that reveal this suprasegmental information are termed prosody (Mitchell, 2007). For example, a "thank you" response with pleasant prosody and with unpleasant prosody can have totally different meanings. Usually, in the context of conversation, emotional expression that is cued by prosody is so subtle and complex that it cannot be easily categorized into some basic emotions that are assessed in simple tone-matching tasks. One method of addressing this issue is to study emotion recognition in a real-life or simulated social context (Green et al., 2005). Moreover, the speculation that the association between deficits in emotion functioning and schizophrenia may occur further downstream at the level of complicated emotion comprehension in social interaction, rather than at the level of basic emotion processing (Hooker and Park, 2002; Kington et al., 2000), needs more empirical support. One more related issue is that utterances that contain performance verbs, or so-called 'speech action' such as performance verbs like 'thanks', 'congratulation' and 'help' in words provide an explicit meaning of intention while previous studies have only focused on the emotion processing itself, rather than intention comprehension, even though this is more associated with an individual's daily functioning. The main aim of this study is therefore to conduct a preliminarily exploration of the effect of prosody and speech action on emotion and intention identification in daily conversation.

2. Results

2.1. Emotion identification

A mixed design ANOVA analysis of the emotion and intention identification accuracy was performed with group (patients with schizophrenia vs. healthy controls) as the between-subject factor and prosody (pleasant vs. unpleasant) and speech action (experiment intention vs. control intention) as the within-subject factors in emotion identification. Both speech action and prosody had a main effect on emotion identification [speech action: $F(1,35)=76.09$, $p<0.01$, conversation with speech action: mean=0.80, SD=0.019, conversations without speech action: mean=0.57, SD=0.021; prosody: $F(1,35)=23.58$, $p<0.001$, pleasant: mean=0.79, SD=0.016; unpleasant: mean=0.58, SD=0.033]. There was a significant difference in emotion identification between the schizophrenia group and the healthy control group (see Table 1 for detail). An interaction was found between prosody and group in emotion identification [Fig. 1a]. Post hoc analysis indicated that the patients with schizophrenia failed to identify the correct emotion when the prosody had a negative tone (post hoc LSD test: $p<0.01$), whereas the healthy controls performed almost equally well with both the pleasant and unpleasant prosody (post hoc LSD test: $p=0.091$).

2.2. Intention identification

A similar analysis was performed with the same independent variable in intention identification. Speech action had a main effect on intention identification [$F(1,35)=19.03$, $p<0.001$, conversation with speech action: mean=0.514, SD=0.015, conversation without speech action: mean=0.585, SD=0.015] in both groups. Prosody had a main effect on intention identification [Table 1, Fig. 1b]. Fig. 1b shows that in intention identification, the healthy controls [post hoc LSD test, $p=0.017$], rather than the schizophrenia group [post hoc LSD test, $p=0.615$], identified intention better with the negative prosody than with the pleasant prosody.

There was a significant difference in intention identification between the schizophrenia group and the healthy control

Table 1 – ANOVA and simple effect in emotion and intention identification.

		ANOVA F value	Schizophrenia (mean/SD)	Healthy control (mean/SD)
Emotion identification	Group	$F(1,35)=4.63^*$	0.76/0.028	0.84/0.027
	Group × prosody	$F(1,35)=5.92^*$	Pleasant: 0.81/0.024	Pleasant: 0.77/0.023
			Unpleasant: 0.50/0.048	Unpleasant: 0.67/0.046
Intention identification	Group	$F(1,35)=2.39$	0.53/0.018	0.57/0.017
	Group × prosody	$F(1,35)=4.48^*$	Pleasant: 0.51/0.043	Pleasant: 0.66/0.042
			Unpleasant: 0.548/0.036	Unpleasant: 0.48/0.035

Note. $^*p<0.05$.

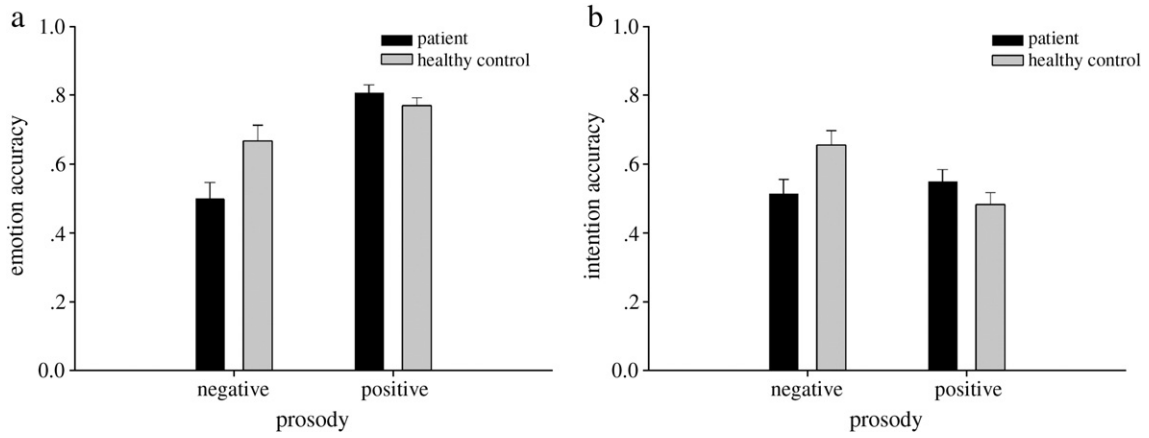

Fig. 1 – a: Interaction between prosody and group in emotion identification; b: interaction between prosody and group in intention identification; the error bars denote SD.

group [patients: mean=0.551, SD=0.021; healthy controls: mean=0.619, SD=0.021, $p=0.027$]. Prosody and speech action had a two-way interaction effect on the intention identification measure [$F(1,35)=39.20$, $p<0.001$]. Post hoc analysis indicated that subjects in both groups identified the intention significantly better [$p<0.01$] with the negative [mean=0.63, SD=0.030] than the pleasant prosody [mean=0.39, SD=0.031] in conversations without speech action, but in the conversations with speech action no significant difference [$p=0.09$] was found for the subjects in both groups in identifying the intention in the pleasant prosody [mean=0.64, SD=0.026] and the unpleasant prosody [mean=0.53, SD=0.039].

3. Discussion

The major findings of this study can be summarized as follows. First, the patients with schizophrenia performed as well as the healthy controls in positive emotion identification, but their categorization of negative emotions was at the chance-level (around 0.5). Second, the patients with schizophrenia, unlike the healthy controls, performed no better in identifying intention with unpleasant prosody than with pleasant prosody. We will discuss each of these major findings below:

That the patients with schizophrenia performed as well as the healthy controls in the identification of positive emotions but not negative emotions is consistent with the findings of previous studies that suggest that patients with schizophrenia are more adversely affected by the recognition of negative facial expressions than by the recognition of positive or neutral expressions, which was consistent with previous researches (Johnston et al., 2006; Kohler et al., 2003; Loughland et al., 2002). Possible explanation for the chance-level identification of emotions with negative prosody among the patients with schizophrenia is the possible cognitive avoidance of negative stimuli (Loughland et al., 2002), which leads to a perceptual bias in processing information such as social threat signals (Arguedas et al., 2006). This was not caused by auditory perception abnormality as revealed in deficient temporal mismatch negativity (MMN) (Naatanen and Kahkonen, 2009) since they performed as well as healthy controls in positive prosody condition. However, this proposition is controversial, because other previous studies have suggested that patients with schizophrenia have a deficit in their ability to recognize happy faces, in contrast to negative faces such as sad or fearful faces (Tsoi et al., 2008). Johnston employed a differential deficit design approach but found that there were no differences in the recognition of any emotional category among patients with schizophrenia (Johnston et al., 2006). Johnston argued that previous evidence of "negative emotion specific deficit" may thus have been due to a difference in task difficulty in the different emotion categories. However, in this study the healthy controls were well able to identify both the positive prosody and the negative prosody, and thus the task difficulty clearly had little influence on their performance. This study therefore provides support for the presence of a specific deficit in negative emotion processing among patients with schizophrenia.

Furthermore, the prosody cue seemed to have no influence on the intention identification among the schizophrenia group, as the patients performed at the chance-level in both the pleasant prosody condition and the unpleasant prosody condition, in contrast to the healthy controls. The inability of patients with schizophrenia to identify the intention of others and the associated neural integration of emotion processing have been extensively documented in a previous study (Abdel-Hamid et al., 2009; Bazin et al., 2009; Kern et al., 2009; Langdon et al., 2006; Ozguven et al., 2008; Roese et al., 2008). This study suggests that this deficit in intention identification may arise from the insensitivity of patients with schizophrenia to speech action, as indicated by the statistical interaction between speech action and group. Speech action provides explicit verbs that reveal the speaker's intention. Insensitivity to this signal in the verbal responses of others may therefore have caused the lack of success of the patients in this study in identifying intention. The current study has provided a potential paradigm for further imaging studies to investigate whether these deficits in intention cue retrieval would be also associated with the abnormality in patients' left medial prefrontal cortex as suggested by previous research (Wakusawa et al., 2007).

However, this study only provides preliminary findings on emotion and intention identification based on the context of conversation. It is also limited by the small sample size, and hence, we could not further investigate the performance in different subtypes of schizophrenia. Subject bias may also have arisen due to recruiting only university students for the pilot testing of the conversation material. Moreover, more types of clinical group such as depression in addition to schizophrenia could be recruited to explore whether the deficits of emotion identification cued by prosody is specific to patients with schizophrenia. Further studies are therefore required to cross-validate the current testing materials in a larger clinical sample.

4. Experimental procedures

4.1. *Subjects*

Eighteen right handed inpatients (7 men; 11 women) with a DSM-IV diagnosis of schizophrenia were recruited from the Guangzhou Brain Hospital and Beijing Anding Hospital. The handedness was administrated by Annett handedness scale (Annett, 1976). Subjects who got scores above zero were regarded as right handed while those below zero as left handed. All of the patients were receiving antipsychotic treatment at the time of the study. The medication was given at a mean dose of 265.23 chlorpromazine equivalent unit mg/day, SD=175.28 (sixteen of the patients took atypical antipsychotic while two of them took typical antipsychotic). The mean duration of illness was 8.076 years (SD=7.25). Clinical symptoms were assessed by trained psychiatrists using the Positive and Negative Syndrome Scale (PANSS score (Kay et al., 1987), total: mean=60.67, SD=14.47; positive: mean=17.26, SD=6.23, negative: mean=16.32, SD=6.21, general: mean=30.3, SD=6.11). Nineteen healthy controls (8 men; 11 women) were also recruited from the community through advertisement. They were screened by the first author of the study using a semi-structured interview to establish the absence of psychiatric history or related illness. Both patients and healthy controls were excluded from the study if they reported current alcohol or drug abuse, a history of head trauma or loss of consciousness. The patients with schizophrenia and control subjects did not differ significantly in age (schizophrenia: mean=40.53,SD=12.58 vs. control: mean=35.26, SD=11.55, $t(35)=0.36$, ns.), education (schizophrenia: mean=11.5, SD=2.71 vs. control: mean=11.52, SD=1.74, $t(35)=1.11$,ns.), IQ estimate (schizophrenia: mean=91.4, SD=17.6 vs. control: mean=84.2, SD=14.9, $t(35)=0.853$, ns.), or BDI score (schizophrenia: mean=8.45, SD=9.84 vs. control: mean=11.58, SD=9.36, $t(30)=0.50$, ns).

4.2. *Development of the conversation materials and pilot data*

The conversation materials used in the study to capture the emotional intentions were developed according to the categories of conversation intention suggested by Holtgraves (2008). Conversations featuring eight intentions commonly encountered in everyday life scenarios were developed, including congratulation, thanks, providing help, blame, complaining, threatening, agreement, and apologizing. In order to ensure that the conversation re-composition was reasonable, the responses in the sixteen conversations were generated by eleven students who were chosen randomly from a university. 45 undergraduates taking an introduction to psychology course (unknown to the conversation material generation) were asked to identify the intention of 16 conversations. The intentions of fourteen from these conversations were correctly identified by more than 50%[2] of the students. Thus we could confirm that the 14 of 16 stimuli matched the original conversation intentions. We developed two sets of conversations for the same scenario, one of which contained speech action in the expressions and the other of which did not. The conversations without speech action were created based on the rationale of speech action theory (Holtgraves, 2008), controlling for semantic associations with different speech actions. Two native speakers were invited to speak the conversations with the confirmed intentions in both positive and negative tones.[3] The mean value for pitch and the intensity of the prosody of the 16 conversations captured by 'praat', the auditory file processing software, were subjected to an ANOVA analysis with prosody (pleasant vs. unpleasant) as the independent variable to ensure that the recordings in each condition had the matched auditory properties. The auditory files with pleasant or unpleasant prosody was same in their intensity [$F(1,16)<0.001$, $p=0.984$], only differed in pitch [$F(1,16)=5.31$, $p<0.05$]. There was no difference in either intensity or pitch between the conversations with and without speech action. The conversation prosody recorded for the 16 conversations with and without speech action was evaluated by 30 students, who judged whether the prosody was pleasant or unpleasant. Conversations with an identification difference of less than 0.4 for the various intentions and prosody types were removed to leave a total of 9 different utterances. In order to evaluate whether the conversation materials generated within the university students could be fully understood by patients with schizophrenia, we have recruited another group of patients with schizophrenia ($n=27$), whose verbal IQ[$t(42)=-1.196$, $p=0.238$], age[$t(43)=0.205$, $p=0.838$] and education background[$t(43)=0.329$, $p=0.744$] were no different from the clinical sample in the current study. This group of patients with schizophrenia could understand the conversation very well since their accuracy of control questions was 1.0 and their accuracy of prosody identification was 0.86±0.27 in negative prosody condition and 0.90±0.19 in positive prosody condition. This suggested that the conversations with positive and negative prosody were also fit for testing in patients with schizophrenia. Finally, four sets of the materials were generated, with each set containing nine utterances with prosody (pleasant vs. unpleasant)×speech action (with vs. without), 9 utterances in each set, 36 conversations in total.

[2] Though 50% may seem just above chance, keep in mind that students needed to choose one intention from six choices, which meant the actual chance level was 16.67%.

[3] All of these conversations were in Chinese. The testing materials can be obtained by contacting the corresponding author.

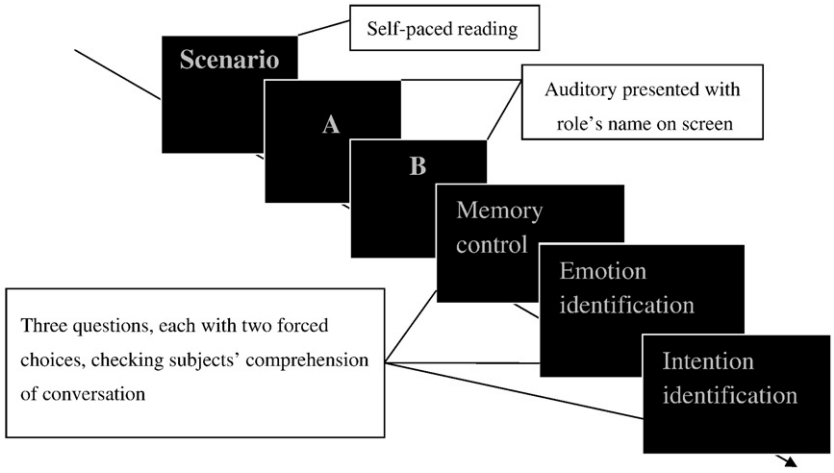

Fig. 2 – Trial procedure illustration.

4.3. *Procedure*

The experiment was conducted on a laptop computer using Eprime software. The subjects first read detailed instructions regarding the task and then engaged in three practice trials. The experimenter provided feedback during the practice trials. Subjects pressed the ENTER key to begin a trial, and one sentence of the scenario then appeared on the screen. The procedure for the trials is illustrated in Fig. 2. Subjects read the scenarios at their own pace and pressed the SPACE key to proceed. The utterances of the speakers in the conversations were presented in audio format at the same time as they were presented on the screen. Three questions with two forced choices each were presented in sequence: memory control, for example, 'Did B say 'thanks'? Yes or No? ' emotion identification, for example, 'What is B's emotion state? Positive or Negative?', and intention identification, for example, 'Did B really want to do XXX? Yes or No?' (cf. Appendix A for detailed illustration).

To reduce the working memory load, subjects were allowed to press the SPACE key to listen to the conversation again before answering the questions. The correct answers had been broadly agreed (53.6%) upon by the university students in the pilot study. The accuracy of the answers to the three questions following each conversation was recorded as the dependent variable for subsequent analysis.

4.4. *Statistics*

To screen out the influence of the working memory deficit that is supposed to exist in patients with schizophrenia, the trials in which the subjects had given incorrect answers to the memory control question were excluded from all of the analyses. A 2 prosody (pleasant vs. unpleasant)×2 speech action (with vs. without)×2 group (schizophrenia vs. control) ANOVA analysis was then performed on the emotion identification and intention identification responses, with the interactions between group and prosody, group and speech action being analyzed.

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Appendix A

Two conversation examples in English:

1) Xiao Li and Xiao He joined the same company at the same time. One year later, Xiao Li is promoted while Xiao He is still on the original position.

(Conversation with speech action—the word 'congratulation')

Xiao Li: I would like to invite you to dinner tonight. I am promoted.

Xiao He: Congratulations (positive prosody or negative prosody with random order).

(Conversation without speech action—the word 'congratulation')

Another colleague: Xiao Li invites us to dinner tonight. He is promoted.

Xiao He: Oh, he is lucky (positive prosody or negative prosody with random order).

Memory control: Did Xiao He say 'Hello'/'congratulation'?

Emotion identification: What is Xiao He's emotion state now? Positive (happy) or negative (jealous)?

Intention identification: Did Xiao He really want to express her congratulations for Xiao Li? Yes or No?

2) Xiao Wang is always careless when doing his work. Xiao Mei is his colleague.

(Conversations with speech action—providing help)

Xiao Wang: I lost a file! What should I do?

Xiao Mei: Don't worry. Let's search for it again. (Positive prosody or negative prosody in random order)

(Conversations without speech action—providing help)

Xiao Wang: I lost my file! What should I do?

Xiao Mei: Don't worry. You could search for it again. (Positive prosody or negative prosody in random order)

Memory control: Did Xiao Mei say 'search for'/'anxious'?

Emotion identification: What is Xiao Mei's emotion state now? Positive (glad to help) or negative (inpatient)?

Intention identification: Did Xiao Mei really want to provide her help for Xiao Wang to search for the file? Yes or No?

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