Prosodic abnormalities in schizotypal personality disorder

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A R T I C L E   I N F O

Article history:
Received 1 June 2012
Received in revised form 31 August 2012
Accepted 5 September 2012
Available online 12 October 2012

Keywords:
Schizotypal personality disorder
Schizophrenia
Prosody
Vocal affect
Pars opercularis
Inferior frontal lobe
Alexithymia
Social cognition

A B S T R A C T

Objective: Patients with schizophrenia speak with blunted vocal affect but little is known regarding the prosody of persons with schizotypal personality disorder (SPD). This work examined expressive prosody in SPD, its relationship to brain structure, and outlined a framework for measuring elements of prosody in clinical populations.

Methods: Twenty-eight antipsychotic-naïve SPD subjects were matched with 27 healthy comparison (HC) subjects. Subjects read aloud short sentences and responded to probes to record both predetermined and self-generated speech samples. Samples were analyzed acoustically (pause proportion, duration, attack, and pitch variability) and subjectively by raters (amount of pauses, degree of emotion portrayed, and how much they wanted to hear more from the subjects) on paragraph, sentence, word, word-fragment, and syllable levels. Alexithymia and ability to self-monitor behavior were compared between groups. The pars opercularis was manually traced on structural MRI data.

Results: SPD subjects’ speech had significantly more pauses, was slower, had less pitch variability, and expressed less emotion than HC subjects. Pitch variability correlated with socio-economic status achievement. There was no difference between groups in left or right pars opercularis volumes. A statistically significant correlation suggested that smaller left pars opercularis volumes in SPD subjects correlated with more pauses and less emotion. SPD subjects reported more alexithymia and difficulty self-monitoring their behavior compared with controls. In SPD subjects the high alexithymia correlated with raters not wanting to hear more from them and SPD subjects’ inability to modulate their social behavior correlated with having fewer friends. Thus, the SPD subjects exhibited insight.

Conclusions: SPD subjects displayed significant prosodic deficits that were measurable in speech samples as brief as a word-fragment. The determinants of these deficits are not known although these may include a dysfunctional pars opercularis. These data add to the nascent literature describing social cognition deficits in SPD.

Published by Elsevier B.V.

1. Introduction

Prosody is the vocal expression of one’s internal emotional state or intent. Key components or elements include pitch, pitch variability, attack, pauses between sounds, and duration of the utterance (Leentjens et al., 1998; Shaw et al., 1999; Leitman et al., 2010; Leitman et al., 2011), (Table 1, Elements). By varying these elements in speech, people transmit subtle distinctions of meaning. Pitch variability may be the most important aspect of prosody (Ross et al., 2001; Leitman et al., 2010). For example, simply modulating pitch can change the expressed emotion from anger to sadness. Similar alterations in amount of pauses, duration of an utterance, or attack, can dramatically affect the sound and cadence of speech and, hence, the expression of emotion and meaning (Monnot et al., 2003). The ability to modulate one’s voice slightly to reflect accurately one’s intention is important for social communication.

Although the hallmark feature of abnormal speech in schizophrenia is in the domain of semantics clinically encapsulated by the term “formal thought disorder”, abnormal vocal affect has been demonstrated as well (Borod et al., 1989; Murphy and Cutting, 1990; Leentjens et al., 1998; Ross et al., 2001; Hoekert et al., 2007). Prosodic deficits initially described by Bleuler included abnormalities of duration, amplitude, and pitch (Bleuler, 1911, 1950; Baltaxe and Simmons, 1995). Further
Table 1
Elements, measurements, and hypotheses. Variables were listed along with how they were measured, comments for clarification of the variable or the measurement, the type of analysis used (either acoustic or subjective), the level of the analysis (speech sample length), the rationale behind inclusion of the variable, and the specific a priori hypotheses associated with the variable. Note that some variables, such as attack, were added post-hoc, and were indicated as such. This table was included for clarification.

<table>
<thead>
<tr>
<th>Prosodic element</th>
<th>Measurement</th>
<th>Comments</th>
<th>Type of analysis</th>
<th>Level of analysis and sample used</th>
<th>Rationale</th>
<th>Hypotheses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acoustic analysis</strong></td>
<td></td>
<td></td>
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<tr>
<td>Pause proportion</td>
<td>Percentage of time the sample contained a pitch above baseline from time of first utterance to final utterance</td>
<td>This would include utterances such as “uh”, for example, as well as proper words</td>
<td>Acoustic</td>
<td>Paragraph (Admire, Store), Sentence (Nutmeg)</td>
<td>Self-generated sentences selected as the natural flow of speech was of interest Nutmeg included in contrast as was neutral and pre-determined sentence Analyses performed “blind” to content</td>
<td>Admire, Store SPD&gt;HC Nutmeg SPD = HC</td>
</tr>
<tr>
<td>Duration</td>
<td>Time from beginning to end of a defined speech sample Beginning and end were determined by detecting a change in pitch</td>
<td>Analogous to how fast someone speaks a given word</td>
<td>Acoustic</td>
<td>Word (“adorable”), Word-fragment (“dora”)</td>
<td>Emotional word “adorable” selected as we wanted to measure the impact of emotion on speech speed “Dora” also included as it was unknown how short an utterance would be necessary to see group differences</td>
<td>“adorable” “dora” No hypothesis</td>
</tr>
<tr>
<td>Attack</td>
<td>Rise in amplitude (loudness) over time for a given phoneme Beginning defined as change in slope from baseline Occasionally slope changed direction, To ensure reproducibility, end defined by maximum amplitude</td>
<td>Analogous with how much “punch” or stress an utterance was said Element added post-hoc as wished to explore as many variables as possible</td>
<td>Acoustic</td>
<td>Syllable (“Nut”, “do”)</td>
<td>“Nut” selected as beginning of neutral sentence “Do” was isolated from “adorable” as visual inspection of data blind to diagnostic group suggested most variation in frequency</td>
<td>“Nut” “do” No hypotheses</td>
</tr>
<tr>
<td>Pitch variability</td>
<td>Standard deviation in Hertz of the pitch maximum and minimum across an utterance, same as the standard deviation of the fundamental frequency</td>
<td>Change in pitch Analogous to amount of variation in inflection</td>
<td>Acoustic</td>
<td>Sentence (Nutmeg, Puppy), Word (“adorable”), Word-fragment (“dora”)</td>
<td>Predetermined sentences used in order to control for content “adorable” and “dora” were included as it was unknown how short an utterance could be and still demonstrate group differences</td>
<td>Nutmeg SPD = HC Puppy SPD = HC “adorable” “dora” No hypotheses</td>
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<tr>
<td>Subjective analysis</td>
<td></td>
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<tr>
<td>Rating of amount of pauses</td>
<td>Mean amount of pauses along Likert scale perceived by raters</td>
<td>Tapped into same aspect of speech as pause proportion above, but subjectively rated</td>
<td>Subjective</td>
<td>Paragraph (Admire, Store)</td>
<td>Self-generated paragraphs used in order to have naturalistic sample Raters likely unable to “blind” themselves to content, that is, their assessments may be affected by content The degree to which raters “tuned out” the “ums” and “ahs” that occur naturally in speech is unknown Self-generated paragraphs used in order to have naturalistic sample Admire minus Store was examined to see if subjects altered the emotional valence of their speech with the more evocative probe, Admire, than they did with the less evocative probe, Store Raters likely unable to “blind” themselves to content, that is, their assessments may be affected by content</td>
<td>Admire SPD&gt;HC Store SPD&gt;HC</td>
</tr>
<tr>
<td>Emotion portrayed</td>
<td>Mean degree along Likert scale that the raters thought the subject spoke with emotion</td>
<td>How emotional the subject sounded Admire minus Store added post-hoc</td>
<td>Subjective</td>
<td>Paragraph (Admire, Store)</td>
<td>Self-generated paragraphs used in order to have naturalistic sample Admire minus Store was examined to see if subjects altered the emotional valence of their speech with the more evocative probe, Admire, than they did with the less evocative probe, Store Raters likely unable to “blind” themselves to content, that is, their assessments may be affected by content</td>
<td>Admire SPD&gt;HC Store SPD&gt;HC</td>
</tr>
<tr>
<td>Hear more</td>
<td>Mean degree along Likert scale that the raters said that they wanted to hear more from the subject</td>
<td></td>
<td>Subjective</td>
<td>Paragraph (Admire, Store)</td>
<td>Self-generated paragraphs used in order to have naturalistic sample Raters likely unable to “blind” themselves to content, that is, their assessments may be affected by content</td>
<td>Admire SPD&gt;HC Store SPD&gt;HC</td>
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