VOCALIZATIONS OF CHILDREN WITH AUTISM SPECTRUM DISORDERS LATE IN THE SECOND YEAR OF LIFE

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Introduction

- Impairment in communication is a primary diagnostic feature of autism spectrum disorders
  (American Psychological Association, 1994)
- Because the average age of diagnosis is still above age 3, little is known about the early communication development of children with ASD
  (National Research Council, 2001; Wiggins, Baio, & Rice, 2006)
- Vocalizations typically develop within the first year of life, therefore this is an area prime for investigation
  (Oller, 1980; Stark, 1980)

Introduction: Previous Research

Vocalizations in ASD

- A lack of syllables with consonants differentiated children with ASD from children with TD, but not DD in the second year of life
  (Wetherby et al., 2004; Wetherby, Watt, Morgan, and Shumway, 2007)

- Atypical vocalizations, such as squeals and growls were found to differentiate children with ASD from children with both TD and DD
  (Sheinkopf, Mundy, Oller and Steffens, 2000; Wetherby et al., 2004)

Vocalizations used interactively

- Children with ASD used a significantly lower proportion of communicative acts with vocalizations than children with TD, but not DD
  (Shumway, in press)

- Use of communicative acts with vocalizations did not differentiate preschool children with ASD from children with DD
  (Wetherby, Prizant, & Hutchinson, 1998)

Vocalizations as predictors of later language skills

- In children with DD, rate of vocalizations and rate of vocalizations used interactively were found to be predictors of later expressive language ability
  (McCaughan, Yoder, & Warren, 1999)

- For children with ASD, inventory of consonants was a significant predictor of nonverbal and verbal developmental quotient (DQ) after controlling for understanding
  (Wetherby et al., 2007)

Purpose

- To support and extend the findings of previous research in the area of vocalizations in young children with ASD; using a large sample size, precise measurement, and systematic observation
Research Aims 1-2

- To examine differences in the vocalizations of children with ASD, DD, and TD between the ages of 18 and 24 months of age
- The use of transcribable vocalizations (TVs) by level of phonetic complexity and number of syllables
- The use of nontranscribable vocalizations (NTVs) by category

Research Aims 3-6

- To examine differences in the communicative vocalizations of children with ASD, DD, and TD between 18 and 24 months of age
  - TVs
  - NTVs
  - Proportion of communicative TVs and NTVs used for functions of behavior regulation (BR), joint attention (JA), and social interaction (SI)

Research Aims 7 and 8

- To describe the concurrent and predictive relationships between precise measures of vocalizations from behavior samples collected between 18 and 24 months and developmental measures in the second year at age 3

Method: Participants

- Three groups of children (ASD, n=50; TD, n=50; DD, n=25) were selected from the FIRST WORDS® Project
- ASD and TD groups were matched individually on chronological age
- ASD and DD groups matched on mental age as determined by the symbolic composite of the CSBS (Wetherby & Prizant, 2002)

Method: Coding

- Vocalizations were coded from archival videotaped CSBS behavior samples using the Noldus Pro Observer® software version XT
- For a previous investigation of the FIRST WORDS® Project (Plumb et al., 2007), vocalizations were coded in three categories: transcribable (TV), nontranscribable (NTV), and could not be determined (CBD)
  - TV - a syllabic vocalization that contains recognizable speech sounds; must contain at least a vowel
  - NTV - a vocalization that is not considered syllabic and either does not contain a vowel or contains a vowel with abnormal phonation, such as a cry/whine or squeal.
  - CBD - A vocalization that cannot be determined as TV or NTV because there is a lack of sufficient auditory and visual information

Table 1

<table>
<thead>
<tr>
<th>Sample Size</th>
<th>ASD</th>
<th>DD</th>
<th>TD</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSBS DP Age in months</td>
<td>21.29 (1.92)</td>
<td>20.64 (1.56)</td>
<td>21.07 (1.75)</td>
</tr>
<tr>
<td>Symbolic SS</td>
<td>5.82 (2.62)</td>
<td>6.52 (2.60)</td>
<td>10.96 (2.56)</td>
</tr>
<tr>
<td>Follow-up Age in months</td>
<td>38.98 (9.83)</td>
<td>35.85 (6.11)</td>
<td>35.45 (5.42)</td>
</tr>
<tr>
<td>Mullen NVDQ</td>
<td>76.00 (25.81)</td>
<td>84.48 (20.12)</td>
<td>114.08 (17.48)</td>
</tr>
<tr>
<td>Mullen VDQ</td>
<td>68.00 (31.11)</td>
<td>76.26 (21.04)</td>
<td>108.93 (15.52)</td>
</tr>
</tbody>
</table>
**TV Categories**

- Phonetic Complexity (adapted from Olswang et al. 1987).
  - Level I – Vocalizations containing a vowel (e.g., /i/), or a CV containing /h/ or a glottal
  - Level II – Vocalizations containing a true, well-formed single consonant or identical consonants
  - Level III – Vocalizations containing two or more different consonants, not including consonant clusters or vocalizations containing consonants differing solely in voicing
  - Level IV – Vocalizations containing well-formed consonant clusters
- Number of Syllables
  - Single Syllable
  - Multisyllable

**NTV Categories**

- Laugh - vocalized burst of air from the lungs typically associated with pleasure
- Distress – includes cry, whine, and scream
- Non-English – includes lip smacks, tongue clicks, and raspberries
- Atypical Phonation – includes yell, squeal, growl, and grunt
- Single Consonant - a consonant produced with no accompanying vowel such as sustained /s/ or an /m/ produced in isolation
- Other – an NTV not captured in the previous categories

**Communicative Acts Coding**

- For a prior investigation of the FIRST WORDS® Project (Shumway, 2006), communicative acts were coded into three categories of function: Behavior Regulation (BR), Social Interaction (SI), and Joint attention (JA)
  - BR – acts used to regulate the behavior of another to obtain a specific result, such as requesting or protesting
  - SI – acts used to attract or maintain another’s attention to oneself, such as requesting comfort, greeting, or showing off
  - JA – acts used to direct another’s attention to an object, event, or topic, such as commenting on an object/action or requesting information

**Method: Interobserver Reliability**

- Interobserver agreement calculated for both TV and NTV categories for 32 randomly selected samples (25.6%)
  - TV categories pooled kappa: 0.86
  - TV categories percent agreement 85 to 91%
  - NTV categories pooled kappa: 0.94
  - NTV categories percent agreement: 85 to 97%

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**Figure 1**
Results: Frequency of Vocalizations

![Graph showing frequency of vocalizations](image1)

*Significantly different than the ASD group*

**Figure 2**
Results: Proportion of TV and NTV out of Total Vocals

![Graph showing proportion of vocalizations](image2)

*Significantly different than the ASD group*
Figure 3
Results: TV Levels
* Significantly different than the ASD group

Figure 4
Results: Number of Syllables
* Significantly different than the ASD group

Figure 5
Results: NTV Categories
* Significantly different than the ASD group

Figure 6
Results: Communicative Vocalizations
* Significantly different than the ASD group

Figure 7
Results: Proportion of TV in Communicative Acts by Function
* Significantly different than the ASD group

Figure 8
Results: Proportion of NTV in Communicative Acts by Function
* Significantly different than the ASD group
Table 3
Results: Concurrent Relationships

<table>
<thead>
<tr>
<th>Vocalization Measure</th>
<th>CSBS Social Composite</th>
<th>CSBS Speech Composite</th>
<th>CSBS Symbolic Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Vocalizations</td>
<td>0.50*</td>
<td>0.63*</td>
<td>0.54*</td>
</tr>
<tr>
<td>TV</td>
<td>0.55*</td>
<td>0.71*</td>
<td>0.58*</td>
</tr>
<tr>
<td>Level I</td>
<td>0.33*</td>
<td>0.14</td>
<td>0.29*</td>
</tr>
<tr>
<td>Level II</td>
<td>0.52*</td>
<td>0.74*</td>
<td>0.50*</td>
</tr>
<tr>
<td>Level III</td>
<td>0.32*</td>
<td>0.76*</td>
<td>0.55*</td>
</tr>
<tr>
<td>Level IV</td>
<td>0.12</td>
<td>0.17</td>
<td>0.14</td>
</tr>
<tr>
<td>Single Syllable</td>
<td>0.57*</td>
<td>0.56*</td>
<td>0.51*</td>
</tr>
<tr>
<td>Multisyllable</td>
<td>0.42*</td>
<td>0.74*</td>
<td>0.52*</td>
</tr>
<tr>
<td>Proportion of TV/all vocals</td>
<td>-0.46*</td>
<td>-0.47*</td>
<td>-0.42*</td>
</tr>
</tbody>
</table>

* p<.05

Table 4
Results: Concurrent Relationships

<table>
<thead>
<tr>
<th>Vocalization Measure</th>
<th>CSBS Social Composite</th>
<th>CSBS Speech Composite</th>
<th>CSBS Symbolic Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of total vocals in acts</td>
<td>0.67*</td>
<td>0.72*</td>
<td>0.65*</td>
</tr>
<tr>
<td>Frequency of TV in acts</td>
<td>0.66*</td>
<td>0.76*</td>
<td>0.64*</td>
</tr>
<tr>
<td>TV in acts for BR</td>
<td>0.71*</td>
<td>0.61*</td>
<td>0.64*</td>
</tr>
<tr>
<td>TV in acts for SI</td>
<td>0.36*</td>
<td>0.58*</td>
<td>0.37*</td>
</tr>
<tr>
<td>TV in acts for JA</td>
<td>0.52*</td>
<td>0.41*</td>
<td>0.42*</td>
</tr>
<tr>
<td>Proportion of communicative vocals</td>
<td>0.58*</td>
<td>0.45*</td>
<td>0.49*</td>
</tr>
<tr>
<td>Proportion of communicative TV</td>
<td>0.56*</td>
<td>0.43*</td>
<td>0.37*</td>
</tr>
<tr>
<td>Proportion of communicative NTV</td>
<td>-0.20</td>
<td>-0.20</td>
<td>-0.19</td>
</tr>
</tbody>
</table>

* p<.05

Table 5
Results: Predictive Relationships

<table>
<thead>
<tr>
<th>Measure</th>
<th>NV DQ</th>
<th>V DQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Vocalizations</td>
<td>0.39*</td>
<td>0.47*</td>
</tr>
<tr>
<td>Total TV</td>
<td>0.36*</td>
<td>0.46*</td>
</tr>
<tr>
<td>Level I</td>
<td>0.17</td>
<td>0.19</td>
</tr>
<tr>
<td>Level II</td>
<td>0.30*</td>
<td>0.44*</td>
</tr>
<tr>
<td>Level III</td>
<td>0.38*</td>
<td>0.45*</td>
</tr>
<tr>
<td>Level IV</td>
<td>0.00</td>
<td>0.03</td>
</tr>
<tr>
<td>Single Syllable</td>
<td>0.34*</td>
<td>0.41*</td>
</tr>
<tr>
<td>Multisyllable</td>
<td>0.30*</td>
<td>0.42*</td>
</tr>
</tbody>
</table>

* p<.05

Table 6
Results: Predictive Relationships

<table>
<thead>
<tr>
<th>Measure</th>
<th>NV DQ</th>
<th>V DQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Vocalizations in acts</td>
<td>0.46*</td>
<td>0.46*</td>
</tr>
<tr>
<td>TV in all acts</td>
<td>0.40*</td>
<td>0.45*</td>
</tr>
<tr>
<td>TV in acts for BR</td>
<td>0.47*</td>
<td>0.43*</td>
</tr>
<tr>
<td>TV in acts for SI</td>
<td>0.24</td>
<td>0.31</td>
</tr>
<tr>
<td>TV in acts for JA</td>
<td>0.30*</td>
<td>0.39*</td>
</tr>
<tr>
<td>Proportion of vocals in acts</td>
<td>0.39*</td>
<td>0.24</td>
</tr>
<tr>
<td>Proportion of TV in acts</td>
<td>0.34*</td>
<td>0.29*</td>
</tr>
<tr>
<td>Proportion of NTV in acts</td>
<td>0.22</td>
<td>0.03</td>
</tr>
</tbody>
</table>

* p<.05

Discussion: TVs

- Children with ASD use fewer vocalizations and TVs than children with TD
- When vocalizing with TVs, children with ASD were as likely to use vocalizations with consonants as both the DD and TD group
- When vocalizing with TVs, children with ASD were as likely to use single syllable and multisyllable TVs as both the TD and DD groups

Discussion: NTVs

- Children with ASD used a comparable number of NTVs as children with TD and DD
- Children with ASD were distinguished from children with TD and DD with the use of a higher proportion of distress NTVs
- When vocalizing, children with ASD are more likely to use atypical NTVs than the TD group
### Discussion: Communicative Vocalizations

- Children with ASD are less likely to use vocalizations in communicative acts than the TD group.
- When communicating vocally, children with ASD are less likely to use TVs in acts for JA than children with TD.
- When communicating vocally, children with ASD are more likely to use NTVs in acts for BR than children with DD.

### Discussion: Concurrent Relationships

- Concurrent relationships
  - In children with ASD, moderate to large correlations between measures of vocalizations and social communication, speech, and symbolic measures on the CSBS were found, indicating a relationship between these domains in the 2nd year of life.

### Discussion: Predictive Relationships

- Predictive relationships
  - For children with ASD, a higher number of total vocalizations and TVs predicted higher nonverbal and verbal development at age 3.
  - A higher frequency of consonants predicted higher verbal development at age 3.
  - A higher number of communicative vocalizations at age 2 predicted higher nonverbal and verbal development at age 3.

### Limitations

- The heterogeneity of the ASD group
- The provision of the CSBS DP in a clinical setting

### Future Directions

- Longitudinal research
- The addition of a comparison group of younger TD children matched on mental age
- A comparative study in a natural environment

### Clinical Implications

- Distress NTVs and signs of emotional dysregulation should be carefully monitored during screening and assessment measures.
- It is important to encourage and teach parents of children vocalizing less often to provide word models and other language learning opportunities. This will provide important feedback that the child may otherwise have missed because of the deficit in vocalizations.
References


References


