Autism as late language acquisition: Low-level learning processes

Inge-Marie Eigsti
University of Connecticut
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Autism diagnosis: Domain 2

Language and Communication
- 25-50% -- nonverbal
- Significant delays
  - First words: 24 months
  - First phrases 36-48 months
- Echolalia: Immediate or Delayed
- Poor conversational skills, less social “chat”
- Unusual speech: speed, volume, prosody (“melody”)

Less pretend play
Language form & use

**Semantics**
- Vocabulary (lexicon)

**Content**
- what you talk about

**Form**
- how you put it together

**Use**
- when and how you communicate it

**Pragmatics**

**Syntax**
- morphology
- phonology

Bloom and Lahey
Mechanism of disorder

- Is not necessarily identical to the phenotype of the disorder
  - Social deficits -> social symptoms
  - Need to look at alternate levels of explanation

Some possibilities:
- Working memory
- Implicit learning
- Purely linguistic constraints
So what about syntax?

- Important findings documenting delays/deficits in acquisition of grammatical morphemes (Tager-Flusberg, Bartolucci, Rapin)

- However, most reviews indicate “no deficits in syntax”
  - Studies of similarities with SLI are exception to this generalization
## Participants

<table>
<thead>
<tr>
<th></th>
<th>Autism</th>
<th>Developmental Delays</th>
<th>Typical Development</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>n=16</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronological Age (months)</td>
<td>57.7 (11.9)</td>
<td>56.9 (9.7)</td>
<td>42.6 (5.7)**</td>
</tr>
<tr>
<td>Receptive vocabulary (PPVT-III Age Equivalent, months)</td>
<td>43 (14)</td>
<td>48 (15)</td>
<td>51 (6)</td>
</tr>
<tr>
<td>Non-Verbal IQ (Stanford-Binet IV Scaled Score)</td>
<td>80 (15)</td>
<td>82 (13)</td>
<td>100 (9)**</td>
</tr>
</tbody>
</table>

**p<.001**
Syntactic complexity in spontaneous production

- 30-minute free play session, videotaped and transcribed.
- Assessed with the Index of Productive Syntax (IPSyn; Scarborough, 1990).

Eigsti et al., 2007, JADD
Findings: Syntactic complexity

- Autism: IPSyn Score = 55.3
- DD: IPSyn Score = 70.9
- TD: IPSyn Score = 76.8

Age Equivalent (months):
- Autism: 28
- DD: 35
- TD: 41

Statistical significance:
- **p < .01
- ***p < .001
Syntax in relation to low-level cognitive processes

• Non-word repetition as a measure of phonological span
  – Span and IPSyn score, $r = .58^{***}$
  – Span and MLU, $r = .42^{**}$

• Mod. A-not-B as a measure of working memory
  – WM and IPSyn, $r = .542^{***}$
  – WM and MLU, $r = .426^{**}$

Eigsti et al., in review
Effects of learning at a later age: Autism as late language acquisition?

Eigsti & Bennetto, in press, *J Child Lang*
## Participants

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<tr>
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<th><strong>Autism</strong></th>
<th><strong>Typical Development</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chronological Age</strong> (years)</td>
<td>13.4 (2.2)</td>
<td>13.3 (2.0)</td>
</tr>
<tr>
<td></td>
<td>10-16</td>
<td>9-17</td>
</tr>
<tr>
<td><strong>Receptive vocabulary (PPVT-III SS)</strong></td>
<td>117 (11)</td>
<td>117 (13)</td>
</tr>
<tr>
<td><strong>Full Scale IQ</strong> (Wechsler or WAIS)</td>
<td>119 (14)</td>
<td>117 (13)</td>
</tr>
</tbody>
</table>
Task

• Grammaticality judgment
  – Structures -> language deficits in late learners of English (Johnson & Newport, 1989)
  – 140 sentences (70 ungrammatical)
    • 14 kinds of structures
    • Sentence length manipulation
Findings: GJ

The graph shows the mean A' scores for different linguistic features across groups with and without ASD. The x-axis represents various linguistic features including Aspect marking, Third person singular, Particle movement, Plurals, Word order, Past tense, Determiners, Auxiliaries, Y/N questions, Wh questions, Pronominalization, Present progressives, and Subcategorization. The y-axis represents the mean A' scores ranging from 0.8 to 1.0. The solid line with squares represents the TD group, while the dotted line with circles represents the ASD group. Significant differences are indicated by asterisks (*) and plus signs (+).
Findings

- ASD: overall less sensitive to grammaticality, $p = .02$
- Deficits: marking of 3rd person sing, present prog, past tense
  - Errors most marked for omissions/substitutions
  - No problems with word order
  - Analogous to late learners in Johnson & Newport
- Errors in longest sentences (10-11 words) but not in short (6-7) or medium (8-9) lengths. Interaction of working memory and grammaticality judgments
Similarity to SLI?

• No: Deficits on verb marking, but NOT on aspect marking
  – Impairments on verbs consistent with Extended Optional Infinitive hypothesis, but with additional structures affected

• Special subgroup? No: 8/10 of young participants scored 1 SD below control mean
Correlational analyses

• Gram judgements associated with vocab. Verbal IQ, and communication skills, but not PIQ
  – Tapping something salient in communicative skills
• GJ associated with 1st production of phrases, $r = -0.42^*$ (even when control for IQ)
  – Tapping developmentally salient phenomenon

• Data consistent with a developmental account where general learnability rather than specific grammatical features impact learning
**Explicit vs. implicit learning mechanisms**

<table>
<thead>
<tr>
<th>Explicit</th>
<th>Implicit</th>
</tr>
</thead>
<tbody>
<tr>
<td>– Deliberate</td>
<td>– Incidental</td>
</tr>
<tr>
<td>– Conscious</td>
<td>– Unconscious</td>
</tr>
<tr>
<td>– Hippocampal/</td>
<td>– Striatal/prefrontal</td>
</tr>
<tr>
<td>temporal</td>
<td>???Intact in ASD????????</td>
</tr>
<tr>
<td><strong>Intact in ASD</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Major goal:** Understand difficulty of generalizations in ASD
Simple implicit learning

Word Segmentation

• Exposure to 20 minutes of connected syllable stream
  – Some syllables cooccur at high frequencies (ie, they group)
  – Other syllables never cooccur
  – After exposure, Grammaticality Judgment (2AFC)
• Done by infants at 9 mos (Saffran, Aslin & Newport, 1999)
• Difficult for children with SLI (Evans, Saffran and Robe, 2009)
Word Segmentation Data

- ASD \((n = 5)\) and TD \((n = 10)\) (to date)
  - Ages 8-16 years \((M = 12)\)
  - Matched on age, PPVT, FSIQ
- *To date*: Everyone above chance, no group differences
  - M’s = 20.3 (4.2) TD, 22.4 (5.3) ASD, out of 36
  - Range of 12-28 (TD) and 14-28 (ASD)
Complex Implicit Task

- 10-item sequence -> where Nemo appears next
- Alternate between 192 sequence and random trials

Typical adults (n = 45): **Change in RT** for sequence trials correlated with **PPVT**, r = .29*, and with verbal **SAT**, r = .38**

Eigsti & Fang, 2006, *Cognitive Science Society*
Very Prelim Findings

- Main effect of Seq vs. Random**
- ASD slower than TD*, less change from Ran to Seq
Summary

- There are clear syntactic and morphological deficits in ASD
  - In younger (3-6 years) and older (9-17 years)
- Working memory and short-term memory span associated with those deficits
- Complex aspects of implicit learning may contribute to syntactic deficits
Why atypical pops?

- Study of atypical populations can inform understanding of typical acquisition -
  - Can see mechanisms at their extreme
  - Highlights relationships between processes that are causally linked, versus those that are simply correlated