Type-Token Ratio Scores:
Establishing Norms for Preschool-Aged Children

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General Review of the Literature: Defining Key Terminology

- Mildred Templin’s (1957, as cited in Retherford, 2000) Type-Token Ratio (TTR) Procedure:
  - Assists speech-language pathologists in examining vocabulary diversity, and thus the development of expressive vocabulary
  - According to Malvern and Richards (1997), obtaining vocabulary diversity data is an essential and valuable component of research that has been done in areas such as child language development
    - “Allows examination of the relationship between the total number of different words used and the total number of words used (Retherford, 2000)”

- According to various sources, TTR has been described as a measure of
  - Vocabulary flexibility (Johnson, 1944, as cited in Hess, Landry, and Sefton, 1986)
  - Lexical diversity (Miller, 1981; 1991, as cited in Hess et al., 1986)
  - Vocabulary diversity (Retherford, 2000)
General Review of the Literature: Defining Key Terminology

- Watkins and Kelly (1995) explained the TTR procedure as:
  - A measure of **linguistic production** derived from a **spontaneous language sample**
  - A **ratio** of the number of different words used to the number of total words used

- Retherford (2000) cited Miller (1981; 1991) and acknowledged that the values compared when determining TTR, the total number of words in a specified language sample and the total number of different words in the same language sample, are most valuable for evaluating the appropriateness of the child’s vocabulary development
  - The actual resulting **TTR ratio is of little significance**

- According to Retherford (2000), “reductions in the total number of different words and the total number of words have been implicated as potential indicators of developmental language delays or disorders”
General Review of the Literature: Vocabulary Development in Children

• Thal and Tobias (1994) acknowledged that, “there is a great deal of variability in the early stages of language development”

• The following data affirmed this contention
  – Smith (1926), as cited in Dale (1976), as cited in Retherford (2003) reported that at 18 months, normally-developing children had the ability to produce 22 meaningful and different words
  – Owens (1992) and Benedict (1979), as cited in Retherford (2003), argued that the normally-developing 18 month-old child could produce nearly 50 different words
  – Nelson (1973, as cited by Retherford, 2003) asserted that the mean age at which children typically were capable of producing 50 different words was 19.75 months
  – Smith (1926, as cited by Dale, 1976, as cited by Retherford, 2003) reported that the typically-developing 21 month-old toddler produced roughly 118 different words
General Review of the Literature: Vocabulary Development in Children

– Thal and Tobias (1994) found that a control group of children, who were a mean age of 23 months, produced an average of 189.5 words that were present on *The MacArthur–Bates Communicative Development Inventories: Words and Sentences* (CDI: WS; Fenson, L., Dale, P., Reznick, S., Thal, D., Bates, E., Hartung, J., Pethick, P., and Reilly, J., 1993)

– According to Rescorla, Ratner, and Jusczyk (2005), toddlers between the ages of 23-25 months received total vocabulary scores of 196.24 words according to the *Language Development Survey* (LDS; Rescorla, 1989)

– Mehrabian (1970, as cited by Retherford, 2003) reported that the expressive vocabulary size of typically developing 2 year-old children was, at least 150 words

– Heilmann, Weismer, Evans, and Hollar (2005) utilized the CDI: WS and found that at 30 months, children produced an average of 264.50 words present on the protocol
General Review of the Literature: 

Early Intervention

• Establishing normative data for vocabulary diversity in the language of toddlers could:
  – Aid in the process of distinguising language delays that would persist without intervention from those that would self-correct (Dale, Price, Bishop, and Plomin, 2003)
  – Aid in the development of screening and surveillance protocols, thus increasing the reliability and the accuracy of these measurements (Baird, Charman, Cox, Baron-Cohen, Swettenham, Wheelwright, and Drew, 2000)

• Norms on vocabulary diversity in the language of normally-developing toddlers could increase the occurrence of accurate identification of language disorders during early childhood, thus resulting in more instances of early intervention
  – Early intervention typically refers to intervention beginning as early as birth and as late as the child’s second birthday (Baird et al., 2000)
General Review of the Literature:

**Early Intervention**

- Early intervention is an important contributor to **achieving the most successful outcomes possible** for a child with a developmental delay or disability (Baird et al., 2000)

- **Counseling the parents of children** with developmental disorders, such as Autism and PDD, is an important component of the early intervention process
  
  - In the case of Autism and Pervasive Developmental Disorders (PDD), fifty percent of parents reported recognizing a problem by the time their child was two years of age, and ninety-three percent of parents reported recognizing a problem by the time their child was four years of age (Baird et al., 2000)

- Consensus of relevant data indicated that having access to normative data for all areas of early childhood development, including language development, and for the purposes of this study, vocabulary diversity, would **assist in warranting early intervention**
Philips (1973, as cited by Retherford, 2000) conducted a study obtaining TTR values for children under 3 years of age, however she only reported the TTR values, and not the total number of words or total number of different words necessary to compute TTR.

According to Retherford (2000), “Templin’s data are applicable only with children between the ages of 3 and 8 years.”

Regarding evaluating vocabulary diversity within the language of children younger than three years of age, Retherford (2000) reports that “until sufficient data are obtained on the diversity of a child’s vocabulary before three years of age, direct application of Templin’s norms is not appropriate.”
The BIG Questions…

• What are the mean total number of words and the mean total number of different words, as measured by Templin’s (1957, as cited in Retherford, 2000) TTR protocol, for children between the ages of twelve and thirty-five months?

• Is there too much variability in the total number of words and the total number of different words used in the expressive language of children ages twelve to thirty-five months to develop normative statistics that could be used in the process of diagnosing an expressive language disorder?
Methods

• Participants
  – Six normally-developing children:
    ▪ Participant A: 28 months
      ▪ Male
      ▪ 3 older siblings
      ▪ Middle to upper-class socioeconomic status
    ▪ Participant B: 30 months
      ▪ Male
      ▪ 1 older sibling, 1 younger sibling
      ▪ Middle-class socioeconomic status
    ▪ Participant C: 31 months
      ▪ Male
      ▪ 2 older siblings, 1 younger sibling
      ▪ Upper-class socioeconomic status
Methods

- Participants continued
  - Participant D: 33 months
    - Female
    - 2 older siblings, 1 younger sibling
    - Middle to upper-class socioeconomic status
  - Participant E: 33 months
    - Male
    - 3 older siblings
    - Middle-class socioeconomic status
  - Participant F: 33 months
    - Female
    - 4 older siblings
    - Socioeconomic status unknown
Methods

• Procedures
  – A 100-utterance language sample was collected from each child
  – A standard set of toys was present for the child to play with during
    the collection of the language sample
    • The set of toys consisted of:
      – Farm and farm animals
      – Race car track with race cars
      – Doll house with doll house pieces
  – A caretaker and the researchers were present during the collection
    of the language sample
  – The individuals interacting with the child were presented with a set
    of guidelines to lead their interactions with the child
    • This helped to elicit the child’s most typical language production
    • Guidelines included suggestions such as asking open-ended
      questions, responding to the child’s comments and questions,
      and parallel talk
Methods

• Procedures continued
  – The middle 50-utterances of each 100-utterance sample were analyzed
  – *A Type-Token Ratio* tally form, located in *Guide to Analysis of Language Transcripts* (Retherford, 2000), was used to complete this process
  – The language samples were transcribed separately by each of the researchers for reliability purposes
  – To calculate the TTR of the 50-utterances, the total number of different words was divided by the total number of words
Methods

• Reliability
  – Inter-judge reliability scores were obtained by evaluating the consistency between researchers from utterance to utterance
  • Each discrepancy resulted in a loss of percentage toward reliability
    – Resulting reliability was roughly 94% agreement

<table>
<thead>
<tr>
<th>Utterance</th>
<th>Total words</th>
<th>Total diff. words</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Results

<table>
<thead>
<tr>
<th>Child</th>
<th>Total # of words</th>
<th>Total # of different words</th>
<th>TTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (28 months) (M)</td>
<td>143</td>
<td>66</td>
<td>0.46</td>
</tr>
<tr>
<td>B (30 months) (M)</td>
<td>120</td>
<td>60</td>
<td>0.50</td>
</tr>
<tr>
<td>C (31 months) (M)</td>
<td>117</td>
<td>50</td>
<td>0.43</td>
</tr>
<tr>
<td>D (33 months) (F)</td>
<td>153</td>
<td>59</td>
<td>0.39</td>
</tr>
<tr>
<td>E (33 months) (M)</td>
<td>155</td>
<td>69</td>
<td>0.45</td>
</tr>
<tr>
<td>F (33 months) (F)</td>
<td>152</td>
<td>69</td>
<td>0.45</td>
</tr>
<tr>
<td>Median</td>
<td>147.5</td>
<td>63</td>
<td>0.45</td>
</tr>
<tr>
<td>Mean</td>
<td>140</td>
<td>62.2</td>
<td>0.45</td>
</tr>
</tbody>
</table>
Discussion of our Results

• The data for vocabulary diversity in the language of 28-33 month-old children (i.e., average total number of words and average total number of different words in the obtained language samples) were measurably different than the data available for 36-41 month old children (however, no statistical analysis was performed on these data)
  – Interestingly, the TTR values resulting from the language samples of the 28-33 month-old children were similar to the TTR values reported for 36-41-month old children
## Discussion of our Results

<table>
<thead>
<tr>
<th></th>
<th>Average total # of words</th>
<th>Average total # of different words</th>
<th>Type-Token-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Templin’s (1957, as cited in Retherford, 2000) norms for children between the ages of 3; 0-3; 5</td>
<td>204.9</td>
<td>92.5</td>
<td>0.45</td>
</tr>
<tr>
<td>The mean score of the data collected from children between the ages of 2; 4 and 2; 9</td>
<td>140</td>
<td>62.2</td>
<td>0.447</td>
</tr>
</tbody>
</table>
So...

- These early data beg further documentation of vocabulary diversity data (i.e., the total number of words and the total number of different words in a 100-utterance language sample) in the spontaneous expressive language of children younger than 36 months at discrete intervals.
Future Studies

• We recommended that researchers control for the following confounding variables while carrying out additional research in this area:
  – Consistent use of standard set of toys
    • We were unable to use the doll house for one of the samples
  – Standard use of recording equipment
    • We had to rely on on-line transcription for half of the samples
      – Difficult to understand some of the samples
  – Consistency with presence/absence of caregiver
    • Primary caregiver not present for all of the samples

• Stay tuned for May 2007 when the results of the thesis inspired by this study are available
References


References


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