Causes of Late Talking and its outcomes

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Sources for this talk
(all in Rescorla & Dale, 2013)

Dale & Hayiou-Thomas, Outcomes for Late Talkers: A Twin Study

Bavin & Bretherton, The Early Language in Victoria Study:
   Late Talkers, Predictors, and Outcomes

Taylor, Zubrick & Rice, Population and Public Health Perspectives on
   Late Language Emergence at 24 Months as a Risk Indicator for
   Language Impairment at 7 years

Thal, Marchman & Tomblin, Late-Talking Toddlers:
   Characterization and Prediction of Continued Delay

Marchman & Fernald, Variability in Real-Time Spoken Language
   Processing in Typically Developing and Late-Talking Toddlers

Rescorla & Dale, Where Do We Stand Now? Conclusions and Future
   Directions
Late Talking: The puzzle, the folklore, the research

Some things we know:

- LT is a risk condition for later problems, but only of modest effect size (Dollaghan review)
- On average, LTs are in the low normal range later (Rescorla, many other studies)
- LTs are highly heterogeneous, especially with respect to comprehension and gestural communication, and degree of grammatical delay (Thal, many other studies) – comprehension is moderately linked to persistent vs. transient delay

but …
there are some core questions for which we have made only modest progress

1. Why are some children notably slow in beginning language development?
   Alternate: if we can’t *explain* late talking, can we at least *predict* these children?

2. Why do many of these children appear to catch up by the beginning of school (even if low range)?
   Alternate: if we can’t *explain* catching up, can we *predict* it, so that intervention can be focused on those who need it most?
3. Would we do better by waiting until age 3?

Unlike some questions (what happens to Late Talkers, what kinds of intervention help, etc.), these 3 questions require large, population-based samples because we need longitudinal data from non-Late Talkers, also the full range of Late Talkers. Consequently, almost all studies have used parent report (LDS, CDI; ASQ) to identify Late Talkers.
Phenotypic predictors of Late Talking

Early Language in Victoria Study (ELVS)

- Low maternal education
- Family history of sp/lang diff
- non-English home language
  even taken together prediction
  very poor; 12 mo CSBS
  helped a bit, but still poor
Phenotypic predictors of Late Talking

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Western Australia Study
- Male
- Preterm birth
- Fetal growth restriction
- Family history of sp/lang diff
- Siblings (not 1st)
- again, poor prediction overall
Twins Early Development Study (TEDS)

Robert Plomin, PI
Funding by UK MRC
Sampling frame: all twins born in England & Wales in 1994-96

Large, longitudinal, multivariate, community study: assessments at 2, 3, 4, 7, 9, 10, 12, 16, 18, ?
Phenotypic predictors of Late Talking

Twins Early Development Study (TEDS; UK)

- Male
- Low maternal education
- Nonverbal ability
- Preterm birth
- Family history of sp/lang diff
- Poor prediction overall

Summary

Consistent findings of relation to male gender, low maternal education; preterm birth; family history ... but low prediction overall
Twin studies, and the etiology of Late Talking

The search for causality

Twin studies: partitioning total variance into that due to
- genetic variance (heritability, $h^2$)
- shared environment (family level, $c^2$)
- nonshared environment (individual level, $e^2$)

Consistent finding of moderate heritability of early language measures ($\sim 0.2-0.4$), rising (!) later
Our question: What is the etiology, not of the full range of ability, but of placement at low extreme?

DeFries-Fulker (DF) analysis used for this purpose; result is called ‘group heritability’, or \( h^2_g \)

Heritability of LT at 2: \( h^2_g = .28 \); at 3: \( h^2_g = .49 \)

Some evidence that group heritability may be slightly higher than individual differences heritability \( h^2 \) across the full range
Twin problems of interpreting twin results

The ‘missing heritability’ problem

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Twin problems of interpreting twin results

The ‘missing heritability’ problem
twin studies tell us genes matter, but molecular studies have not been very successful at finding the genes

The ‘missing environmentality’ problem
twin studies tell us the environment matters even more, but behavior studies have not been very successful at finding the environment factors

compare estimates of environmental influence from twin studies with correlations with SES, parental language style, etc., from behavioral studies
Phenotypic predictors of catching up

Relatively little evidence here, as most studies contrast LT and TD children at the group level.

ELVS, predicting to 4: gender, birth order, English-speaking background, family history (all as at 2), plus maternal vocabulary, maternal education, SES

Thal et al, predicting from 16 to 28 months: severity of expressive delay, comprehension, gestures

Rescorla: receptive language, nonverbal ability, SES, ‘typical personality development’
A twin study of catching up (TEDS)

Bishop et al (2003), predicting from 2 to 4:

Higher concordance of outcome for MZ than for DZ pairs

Higher $h^2_g$ heritability for LT-2 twins whose delay persisted than those who recovered if an outcome of delay is defined by parental concern & professional involvement, not language measures (parent report) probably reflects parental sensitivity to speech, and to pragmatics difficulties
Later outcome measures

Odds Ratio as a measure of phenotypic prediction from delay at 2 to low performance (< -1.25 SD) on later measures

Late Talking alone as a predictor of delay in
NC Speaking & Listening at age 7: OR = 2.97
Receptive language at age 12: OR = 2.23
Reading composite score at age 12: OR = 1.59

Can we do better using additional information?
Significant prediction from gender, preterm birth, family history, maternal education, nonverbal ability, ear infections; but even together, no better than default
Would we do better if we waited until 3?

Heritability of LT-2: $h^2_g = 0.28$; LT-3: $h^2_g = 0.49$

Conclusion: Yes, better, but still not great …
These are relatively weak associations, but why are they there? How much of the continuity is due to common genetic effects and how much to common shared environment effects?

<table>
<thead>
<tr>
<th>Measure</th>
<th>From LT-2 Genetic contrib.</th>
<th>From LT-2 Shared envir cont.</th>
<th>From LT-3 Genetic contrib.</th>
<th>From LT-3 Shared envir cont.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC Speaking &amp; Listening – 7</td>
<td>56 %</td>
<td>35</td>
<td>44</td>
<td>56</td>
</tr>
<tr>
<td>Receptive Lang – 12</td>
<td>0</td>
<td>75</td>
<td>36</td>
<td>62</td>
</tr>
<tr>
<td>Reading - 12</td>
<td>0</td>
<td>75</td>
<td>50</td>
<td>54</td>
</tr>
</tbody>
</table>

Shared environment plays a substantial role, but especially from age 3 on, common genetic factors are important – But what are they?
Issues for future research

What is the most appropriate criterion for LT? (gender differences, bilingual populations …)
The heterogeneity (receptive ability, grammatical delay, etc.) of LT: what is the breakdown statistically in the population? And how can we best intervention to individual LTs? (Finestack talk)
When & how influential is SES, and where, and what are those missing environmental influences?
Will process measures do a better job of predicting catching up? Fernald & Marchman LWL paradigm
Figure 8.1. A) Configuration of test booth with rear-projection screen used in the looking-while-listening procedure; B) schematic timeline for a typical trial. (From Fernald, A., Zangl, R., Portillo, A.L., & Marchman, V.A. [2008]. Looking while listening: Using eye movements to monitor spoken language comprehension by infants and young children. In I. Sekerina, E.M. Fernández, & H. Clahsen [Eds.], Developmental psycholinguistics: Online methods in children’s language processing [pp. 97–135]. Amsterdam, Netherlands: J. Benjamins; adapted by permission.)
Figure 8.6. Time course of the mean proportion fixating the target picture on distractor-initial trials at 18 months as a function of vocabulary outcomes at 30 months. Dark squares indicated those late talkers (LTs) who “bloomed”; open squares indicate those LTs who remained delayed at 30 months. Error bars represent standard errors (SE) of the mean. (From Fernald, A., & Marchman, V.A. [2012], Individual differences in lexical processing at 18 months predict vocabulary growth in typically developing and late-talking toddlers. Child Development, 83, 203–222; adapted by permission.)
Thank you!