The Same is Not Equal: The Case for Treating Poverty as a Biological Determinant of Language Challenge

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Problem

*Poverty negatively impacts language learning, d = 1.0.
*Typically attributed to SES-associated differences in parental language input.
*But language input only accounts for roughly 10 percent of variance in language outcomes.

PROBLEM: What accounts for the rest of the variance in language outcomes?

Main Findings

3 social factors correlated with SES:
- number of maternal inquiries to child
- life stress
- knowledge of child development

Biological factors of temporal and spectral modulation sensitivity correlated with SES, as well

FINDING: Modulation sensitivity explained the most variance in language outcomes, especially phonological.

Major Takeaway

Post implantation, children living in poverty face a greater risk of delay in development of the central auditory pathways than mid-SES children.

Clinical management must address these risk factors, in addition to traditional language interventions.

BACKGROUND

Poverty significantly hinders language acquisition with effect size = 1.0; this means poverty has as strong of an effect as profound deafness.

Predominant models implicate differences in amount and kind of language input as the source of poverty's effect, known as the '30-million-word gap.'

But language input only accounts for roughly 10 percent of variance in child language outcomes.

And in addition…

Poverty has been shown to delay cortical development and slow myelinization.

This effect has not been examined as a potential predictor of language acquisition.

How does slowed development of central pathways affect language acquisition?

AIM OF CURRENT RESEARCH

Address Questions:

1. Does sensitivity to temporal and spectral modulation (metrics of the function of the central auditory system; i.e., biological factors) explain as much or more variability in language outcomes as social factors?
2. Does modulation sensitivity explain more variability in phonological sensitivity than lexicosyntactic knowledge?

METHODS

Procedures approved by the Institutional Review Board of the University of Florida.

102 Participants: Mother & Child

Criteria
5;0 to 6;11 years of age
English-only at home
Auditory Thresholds < 20 dB HL
Gestational age > 34 weeks
No other risk factors

SES group	Number
Poverty	34
Working	21
Middle	32
High	15

Maternal Measures

Language input style: 10-min video of Tinker-toy task inquiries, directives, explanations, & total
Life stress: Parenting stress index
Knowledge of child development (K-of-D)

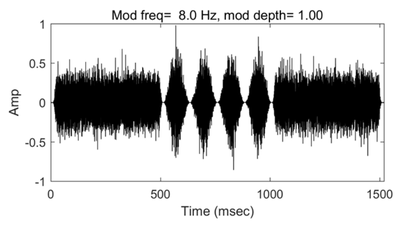
Child Language Measures

Lexicosyntactic:
Expressive vocabulary (EOWPVT-4)
Auditory comprehension (PLS-5)

Phonological Sensitivity:
Initial consonant matching (3 choice/match to target)
Rhyme oddity (3 choice)

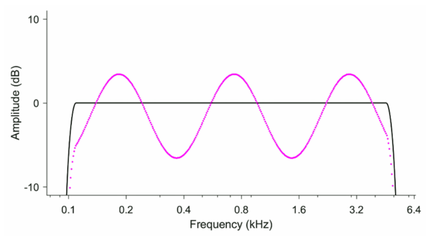
Modulation Sensitivity (depth detection)

Temporal modulation at 8 Hz



*3 interval choice
*2 down, one up
*10 reversals
*mean of last 8
*70.7% threshold

Spectral modulation at 0.5 cpo



DESCRIPTIVE RESULTS

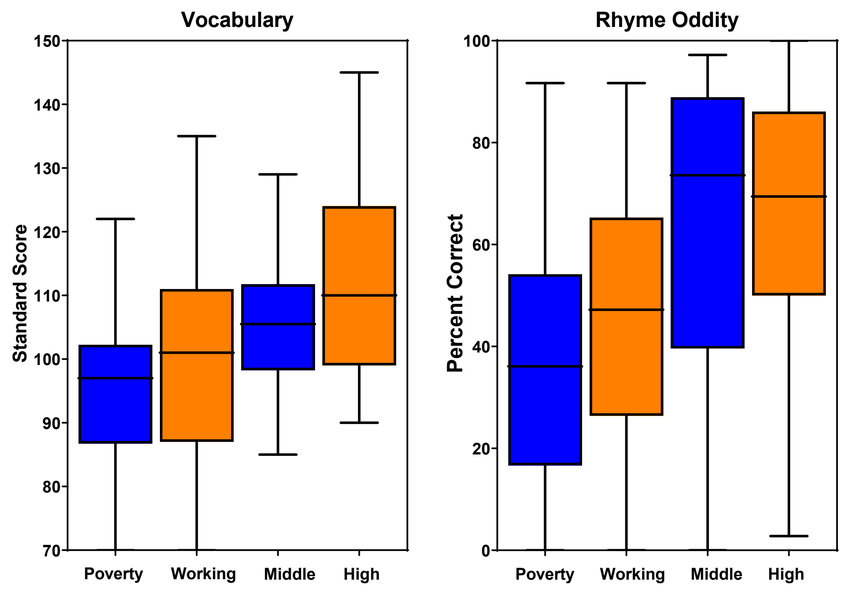
SES is associated with 3 maternal measures and all modulation sensitivity measures.
Means for 4 SES groups (p shown), plus Pearson r for SES as continuous variable.

Measure	Poverty	Working	Middle	High	Pearson r (SES)
Inquiries (.007)	23	26	32	34	.325
Life stress (<.001)	11	15	7	6	-.276
K-of-D (<.001)	19	20	22	23	.477
Temporal 8 Hz (.016)	-12	-11	-14	-17	-.263
Spectral .5 cpo (.023)	20	23	18	14	-.224

SES is associated with all 4 measures of child language.
Pearson r for SES as continuous variable.

	Lexicosyntactic		Phonological Sensitivity	
	Vocab.	Aud Comp	Rhyme	Init. C
SES	.364	.340	.339	.306

Illustrative example of SES effects across groups



EXPLANATORY RESULTS

Knowledge of child development (K-of-D) is only social determinant that explains any variability in child language outcomes.
Modulation sensitivity explains lion's share of variability.

Tables below show results of stepwise regression analysis including 3 maternal measures and modulation sensitivity.

Vocabulary

Step	Measure	standard β	t	p
1	Spectral .5	-.425	-4.63	<.001
2	Spectral .5	-.353	-3.88	<.001
	K-of-D	.288	3.17	.002

Auditory Comprehension

Step	Measure	standard β	t	p
1	Spectral .5	-.425	-4.62	<.001
2	Spectral .5	-.347	-3.85	<.001
	K-of-D	.308	3.42	<.001

Rhyme Oddity

Step	Measure	standard β	t	p
1	Temporal 8	-.466	-5.17	<.001
2	Temporal 8	-.410	-4.66	<.001
	K-of-D	.282	3.21	.002
3	Temporal 8	-.265	-2.47	.015
	K-of-D	.255	2.93	.004
	Spectral .5	-.245	-2.27	.026

Initial Consonant Matching

Step	Measure	standard β	t	p
1	Spectral .5	-.490	-.5.54	<.001
2	Spectral .5	-.418	-4.80	<.001
	K-of-D	.285	3.27	.002

Modulation sensitivity explains more variability in phonological measures than in lexicosyntactic measures.

Table below shows Pearson r for measures that explained any variability and language measures.

	Lexicosyntactic		Phonological Sensitivity	
	Vocab.	Aud Comp	Rhyme	Init. C
K-of-D	.364	.363	.349	.369
Temporal 8 Hz	-.291*	-.391	-.484	-.452
Spectral .5 cpo	-.410	-.420	-.454	-.478

CONCLUSIONS

*Children with cochlear implants are at risk of poor modulation sensitivity. For children in poverty, this risk is even greater. ***It is a biological determinant.***
*Maternal knowledge of child development explained significant variability in language outcomes for these children.
*Maternal language input explained no variance in language outcomes for these NH children, but previous work showed effects for children with cochlear implants. Thus, SES differences in language input will have effect for children with CIs.

Intervention programs for children with cochlear implants in poverty need to:
-continue parent coaching of communication style
-provide guidance about child development
-monitor auditory environments and modulation sensitivity to optimize development of central auditory pathways.

Acknowledgements

This work was supported by Grant R01 DC020918 from the National Institutes of Health, National Institute on Deafness and Other Communication Disorders to Susan Nittrouer.