

THE POWER OF **Talk**

Adult Talk and Conversational Turns During the Critical 0-3 Years of Child Development

Infoture, Inc. Technical Paper

By Jill Gilkerson, Ph.D. and Jeffrey A. Richards, M.A.

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ITR-01-1

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This study by Infoture examines the relationship between parent talk and child language development. The study sought to confirm and extend the results of a breakthrough study released in 1995 by Betty Hart, Ph.D. and Todd Risley, Ph.D. Hart and Risley asked why some children do better academically than others. They determined that a child's intellectual success is directly related to the amount of talk the child hears from birth to age three.

The key findings of the Infoture study include the following:

- Parents of advanced children—children who scored consistently between the 90th and 99th percentile on independent standardized language assessments—spoke substantially more to those children than parents of children who were not as advanced, confirming the Hart and Risley study.
- Parents estimated that they talked more with their children than they actually did.
- Most language training for children came from mothers, with mothers accounting for 78 percent of total talk.
- Mothers talked more to daughters than mothers talked to sons.
- Parents talked more to first-born children than to children who followed in the birth order.
- Most adult talk between parent and child occurred in the late afternoon and early evening compared to other times of day.
- Children of talkative parents were also talkative.
- While the average daily speech for parents who graduated from college was higher than for all other parents, the average daily speech for the upper 50 percent of parents who did not complete high school was significantly higher than that of the lower 50 percent of parents who graduated from college.

By Todd Risley, Ph.D.

Professor Emeritus of Psychology, University of Alaska

Senior Scientist, Schiefelbusch Institute for Life Span Studies, University of Kansas

In 1995, Betty Hart and I released the findings of a longitudinal research study that we had conducted for over a decade. Our book, *Meaningful Differences in the Everyday Experience of Young American Children*, described how we learned that the most important ingredient in the recipe for a child's future academic success is the sheer volume of talk that the child's parents have with the child—from the child's birth until age three.

It was a study rooted in the history of the War on Poverty. We knew long before we conducted our study that children differed greatly in how fast they acquired language skills and subsequently developed academically. We wanted to know why.

We discovered that race and ethnicity has no bearing on a child's academic success. In fact, even disadvantages attributed to socioeconomic status can be overcome. What matters is this: The more parents talk with their child from birth to age three, the more likely their child will excel academically later in life. And that sets the stage for other successes in the child's future.

If a parent only talks a little bit, the conversation is only about business. "Stop that." "Get down from there." "Come here." But when a parent advances the conversation beyond business, the topics automatically change. The words used in conversation change, too. And that makes all the difference later in the child's intellectual life.

As is the case with most academic studies, we encountered certain limitations. The first was that we observed and recorded our 42 participants for only one hour every month. Also, the youngest children in our study were about seven months old, so we could only speculate about language development for children younger than that.

In 2006, Infoture developed LENA™, which stands for Language ENvironment Analysis. This remarkable technology is unlike any other tool available—for parents or researchers. With LENA, Infoture recorded the conversations between 314 children and their parents for 12-hour periods once a month for six to 11 months. The average number of 12-hour recordings per child was five. The children's ages ranged from two months old to 36 months old.

By using LENA, Infoture verified what Betty Hart and I had uncovered—that children who hear more words from birth to age three have more sophisticated language skills than children who don't hear as many words. In other words, talk is the greatest tool parents can use to develop their child's intellectual skills. Infoture also gained insights into the patterns of talk between parents and their children, when during the day that talk occurs more often and when talk occurs less.

Of course, it is critical that parents know they are talking enough with their children. And that's where LENA comes in. LENA makes it possible for parents to know exactly how much they talk with their child.

It was professionally satisfying and exciting, as you might imagine, generating a study that educators, speech professionals, pediatricians, government officials, and parents have come to find important. And it's equally satisfying and exciting to see our study confirmed—and new findings unveiled—with the use of a revolutionary new tool such as LENA.

Todd Risley, Ph.D.

University of Kansas

December, 2006

About the Hart & Risley Study (1995)

*Meaningful Differences in the Everyday Experience of Young American Children*¹ describes the findings of Betty Hart, Ph.D., and Todd R. Risley, Ph.D. Their longitudinal study of parent-child talk in families in Kansas was conducted over a decade. A team of researchers recorded one full hour of every word spoken at home between parent and child in 42 families over a three year period, with children from seven months to 36 months of age. The team then spent six additional years typing, coding, and analyzing 30,000 pages of transcripts.

Follow-up studies by Hart and Risley of those same children at age nine showed that there was a very tight link between the academic success of a child and the number of words the child's parents spoke to the child to age three.

Hart and Risley categorized participants based on socioeconomic status. The study included the following demographics:

- 13 families in the upper socioeconomic stratum
- 10 families in the middle socioeconomic stratum
- 13 families in the lower socioeconomic stratum
- 6 families were on welfare
- 17 families were African American
- 23 children were female, and 19 were male

They and their team observed and recorded parent-child talk during the late afternoon or early evening, a time when there is typically more conversation in the home.

At the conclusion of the observation phase, Hart and Risley had 1,318 hour-long transcripts. From the recordings, their team coded interactions between the parents and children. They coded words into four categories: nouns, verbs, modifiers (adjectives and adverbs), and function words (pronouns, prepositions, demonstratives, and articles). Other sounds, such as animal and vehicle sounds, and utterances that were sentences or phrases were also coded. The process to transcribe, code, and analyze the conversations took the Hart and Risley team about six years.

¹ Hart, B.S. & Risley, T.R. (1995) *Meaningful Differences in the Everyday Experience of Young American Children*. Baltimore. Paul Brookes. (1.800.638.3775)

The study of 42 children in Kansas uncovered three key findings:

1. The variation in children's IQs and language abilities is relative to the amount parents speak to their children.
2. Children's academic successes at ages nine and ten are attributable to the amount of talk they hear from birth to age three.
3. Parents of advanced children talk significantly more to their children than parents of children who are not as advanced.

The differences in talk between families was significant

Certainly, it came as no surprise to Hart and Risley that some families talked more than others. What surprised the researchers was how significant the differences were between families. Some parents spent more than 40 minutes in an average hour interacting with their child, while other parents spent less than 15 minutes. Some parents responded more than 250 times an hour to their child; others responded fewer than 50 times. Some parents expressed approval and encouragement of their child's actions more than 40 times an hour; others less than four times. Some parents spoke an average of more than 3,000 words per hour to their child; others spoke fewer than 500 words. By age three, the differences in each child's language experience were significant: some children had heard nearly 33 million words; others only 9 million.

This finding is particularly notable because the child's rate of vocabulary growth, vocabulary use, and IQ score was more strongly related to the number of words a parent said per hour than any other variable including parents' education or socioeconomic status.

[FIGURE 1]

AVERAGES FOR MEASURES OF PARENT AND CHILD LANGUAGE AND TEST SCORES (HART & RISLEY 1995)

MEASURES AND SCORES	FAMILIES					
	13 PROFESSIONAL		23 WORKING-CLASS		6 WELFARE	
	Parent	Child	Parent	Child	Parent	Child
IQ score at age 3		117		107		79
Recorded Vocabulary size	2,176	1,116	1,498	749	974	525
Average utterances per hour	487	310	301	223	176	168
Average different words per hour	382	297	251	216	167	149
Average adult words per hour	2,153		1,251		616	
Average total adult words per 14-hour day	30,142		17,514		8,624	

The link between children's experiences and their outcomes

Hart and Risley discovered, "With few exceptions, the more parents talked to their children, the faster the children's vocabularies were growing and the higher the children's IQ test scores at age three and later." The amount of parent talk accounted for the verbal and intellectual accomplishments of the children in their study.

In fact, according to Hart and Risley, the measure of accomplishments at age three predicted measures of language skills at ages nine and ten. Thus, the importance of the first three years of a child's experience cannot be underestimated.

LENA is the world's first automatic natural language environment analysis system for infants and toddlers. Terry Paul, who with his wife Judi, began Infuture to develop LENA.

After reading *Meaningful Differences in the Everyday Experience of Young American Children*, Terry wanted to help parents lay the foundation on which their children could build life's successes. So he gathered a world-class team of engineers, research academicians, linguists, and speech-language professionals who spent three years and millions of dollars researching and developing LENA.

The LENA System includes

- The LENA Digital Language Processor (DLP) that captures up to 16 hours of conversation between a child and his or her caregivers.
- Two pieces of LENA Clothing, with a specially designed pocket that holds the DLP and allows the child to play unencumbered while the DLP accurately captures conversations all day long.
- State-of-the-art LENA Language Environment Analysis Software.
- Feedback reports that provide information regarding the child's natural language environment: the number of adult words the child hears in a day and the number of conversational turns the child engages in throughout the day.

Once LENA was perfected, Infuture collected the world's largest database of spontaneous adult-child speech interactions in the natural home environment. This database is the basis for the analyses reported here, and leading researchers worldwide will draw from it for academic studies and publications.

How LENA accurately measures talk

The LENA Digital Language Processor captures every utterance between parent, or other caregiver, and child. Then the software uses advanced algorithms to analyze the conversations and compute the number of words the child hears, as well as the number of conversational turns the child experiences when the parent talks and the child responds, and vice versa.

The accuracy of the LENA System is remarkable. Based on 70 half-hour test files from 70 different families (children two months to 36 months), LENA had a mean per-hour error rate of 2.4 percent compared to human transcribers. This error rate is very low considering that LENA can count and analyze from 14,000 to 20,000 or more words per day. Accuracy for individual families may be better or worse due to various sources of noise in the environment and confusion between non-speech noises and adult-child talk. Higher potential error rates are mitigated by the fact that, over time, errors tend to cancel out because relative values and relative change in the number of adult words and conversational turns are more important than absolute values.

The LENA Software is particularly unique in that Infuture's engineers adapted the software to work in unstructured environments. Doing so enables LENA to discern between near and far speech and to filter out child crying and vegetative sounds, as well as voices from a radio or television.

In their study, Hart and Risley recorded one hour of conversation during a specific day every month—typically during the late afternoon or early evening. They counted the adult words and child vocalizations in that hour, and then extrapolated those findings across 14 waking hours to estimate the total number of adult words that their participants experienced. As a result, Hart and Risley estimated that children with advanced language skills would have heard more than 33 million words in the first three years of life. That's 30,000 words every day.

Using LENA to record an entire 12-hour day of language experience with 314 participants enabled Infoture to accurately estimate the number of adult words that children in an enriched language environment hear in the first three years of life: almost 22 million words, or about 20,000 words every day. With LENA we could see for the first time the pattern of talk during the entire day, showing that talk peaks during the late afternoon and early evening (something that Hart and Risley could not have known). Considering the fact that Hart and Risley extrapolated their estimate of 33 million words based on one hour of recording at peak talk hours, the LENA estimate based on 12-hour days and the Hart and Risley estimate based on 14-hour days are amazingly similar.

LENA Software development

To create the LENA Language Environment Software, Infoture scientists constructed algorithms and mathematical models utilizing over 18,000 hours of recordings from 314 families. The recordings were repeatedly fed into a specially designed super computer with 148 parallel processors and 27,300 gigabytes of storage.

LENA filters out far field speech and estimates the number of words spoken by any adult—mother, father, or visitor—in the same room as the child.

LENA uses similar rules to Hart and Risley's to measure conversational turns. A conversational turn is considered to have occurred when a child vocalizes and an adult responds, or an adult speaks and a child responds. Each time that happens, one turn is counted.

One child vocalization is counted when a child's speech sound of any length is surrounded by at least 300 milliseconds of silence.

LENA also filters out the majority of non-speech sounds a child makes. Such sounds include vegetative sounds—those that have to do with respiration or digestion—as well as cries, screams, and whining sounds.

The LENA developmental snapshot

As part of the LENA System, Infoture developed the LENA Developmental Snapshot (LDS) comprising a 52-question parent survey regarding expressive and receptive language skills, and the resulting information about a child's developmental age from two months to 36 months. Infoture investigated the accuracy of the LDS by comparing its estimated developmental age with the developmental age estimates of various standardized assessments. The LDS was highly correlated with standardized assessments (Pearson's $r = .93$, $p < .001$). (Figure 2)

[FIGURE 2]

LENA DEVELOPMENTAL SNAPSHOT HIGHLY CORRELATES TO STANDARD LANGUAGE ASSESSMENTS

	N (SAMPLE SIZE)	CORRELATION ¹
PLS-4 Receptive Language	51	.93**
PLS-4 Expressive Language	51	.92**
REEL-3 Receptive Language	75	.96**
REEL-3 Expressive Language	75	.96**
CDI Receptive Language	143	.84**
CDI Expressive Language	142	.81**
CLAMS	52	.97**
CAT	52	.95**
Overall Average		.93**

**Correlation is significant at the .01 level (2-tailed)

¹ Developmental age for LENA Developmental Snapshot is correlated with the developmental age for standard assessments

There were 314 participants in the Infoture study. The participants were recorded for 12 consecutive hours one day each month for six months to 11 months between January, 2006 and December, 2006. Infoture recorded 1,654 sessions that were longer than 10 hours. Of those, 1,525 sessions were at least 12 hours long. Rather than extrapolate findings of the sessions that were shorter than 12 hours, Infoture eliminated them. Despite eliminating 129 recording sessions, Infoture still had 18,300 total hours of spontaneous speech data to analyze; to our knowledge, the world's largest database of parent-child speech in the natural home environment.

The children in the study were between two months and 36 months of age, and there were eight children in each age-month interval. Every month Infoture added more two-month-old children to the study to compensate for those preceding them who grew one month older. Infoture continued studying the children who grew older than 36 months during the study.

The sample was recruited from the Denver, Colorado metropolitan area through newspaper ads and direct mail solicitations. Over 2,000 people asked to participate, and Infoture narrowed the group to match the United States census, in terms of the education level of the participants' mothers. (Figure 3)

[FIGURE 3]

LENA DATA REPRESENTATIVE OF US CENSUS

MOTHERS' EDUCATION LEVEL	N	% LENA SAMPLE	% US CENSUS ¹
Less Than High School	73	23%	22%
High School Diploma	76	24%	26%
Some College	89	29%	29%
College and Higher	76	24%	23%
Total	314	100%	100%

¹US Census Bureau (2004): Population of women 15-44 years of age

This group of 314 participants formed the sample for Infoture's normative study, contributing the data supporting the first-ever percentile norms for daily adult word counts and conversational turns. At the conclusion of the normative study, Infoture has retained 80 of the participants and continues to study them longitudinally. Recordings from the longitudinal study are included in the current analysis.

LENA percentiles for adult word counts and conversational turns

An important result of the Infoture study is the first-ever percentile estimates (norms) for daily adult word counts and conversational turns (12-hour days).

[FIGURE 4]

PERCENTILE NORMS FOR ADULT WORD COUNTS AND CONVERSATIONAL TURNS PER 12-HOUR DAY (AGES 2 MONTHS – 36 MONTHS)

PERCENTILE	ADULT WORD COUNTS	CONVERSATIONAL TURNS ¹
99th	20,943	960
90th	16,534	740
80th	14,677	647
70th	13,338	580
60th	12,194	523
50th	11,124	470
40th	10,055	417
30th	8,911	359
20th	7,572	293
10th	5,715	200

¹ Percentiles shown for conversational turns are averaged across ages 2-36 months. Because conversational turns increase with age, percentiles are age-dependent and vary from month to month in the LENA Software.

One of the most interesting aspects of this normative table is the large variation between the 90th percentile and the 50th or 10th percentiles. Parents at the 90th percentile talk 1.5 times more than parents at the 50th percentile and nearly 3 times more than parents at the 10th percentile.

The Infoture study supports the conclusions that Hart and Risley drew from their study. Children's scores on language and cognitive assessments are highly predictable based on talk and conversational turns with the parent.

Correlation with standardized assessments confirms Hart and Risley findings

Infoture retained certified Speech Language Pathologists who measured the language skills of each participant during independent observation sessions. These measures then were correlated to Adult Word Count (AWC) and Conversational Turns (CT). Adult word counts and conversational turns, as a measure of how much interaction there is between parent and child, correlate well with standardized measures of language. This confirms the Hart and Risley findings using a much larger sample. (Figure 5)

[FIGURE 5]

ADULT WORD COUNTS AND CONVERSATIONAL TURNS CORRELATE TO STANDARD LANGUAGE ASSESSMENTS

	N ¹	CORRELATION ²	
		AWC	CT
PLS-4 Receptive Language	43	.20	.40**
PLS-4 Expressive Language	43	.33*	.50**
PLS-4 Total Language	43	.27	.46**
REEL-3 Receptive Language	21	.42	.54**
REEL-3 Expressive Language	21	.44*	.64**
REEL-3 Total Language	21	.44*	.61**
CAT/CLAMS Expressive and Receptive Language	20	.41	.57**
Overall Average		.31*	.47**

*Correlation is significant at the .05 level (2-tailed)

**Correlation is significant at the .01 level (2-tailed)

¹Sample includes children 31-36 months.

²Adult word counts and conversational turns are correlated with the standardized ability scores of standard assessments.

Advanced children have parents who talk more

Infoture confirmed that parents of advanced children—children who scored consistently between the 90th and 99th percentile on independent standardized language assessments—talked significantly more to their children than parents of less advanced children. The parents of advanced children also engaged in significantly more conversational turns with their children. (Figure 6)

[FIGURE 6]

CHILDREN WHO ARE ADVANCED ON STANDARD LANGUAGE ASSESSMENTS HAVE PARENTS WHO TALK MORE

	N	AVERAGE AWC	AVERAGE CT
ADVANCED 90th-99th Percentile On Standard Assessments	38	13,227	688
NON-ADVANCED 1st-89th Percentile On Standard Assessments	252	10,880	474

*Advanced/non-Advanced comparisons are significant at the $p < .01$ level.

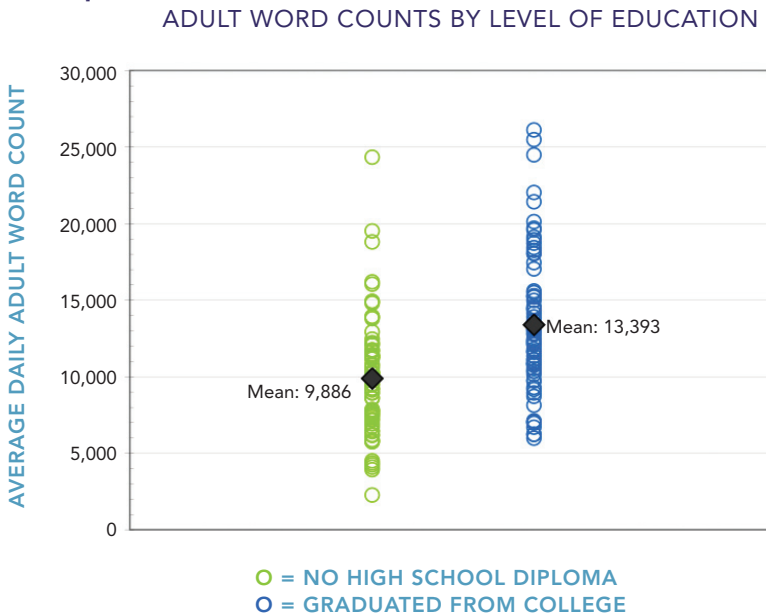
The difference in the mean number of adult words spoken to advanced children compared to all other children is 2,347 words. In a 12-hour day, that is a difference of 196 words per hour.

The mean difference in conversational turns between advanced children and their parents compared to all other children is 214 turns in a 12-hour day, or almost 18 additional turn-taking events an hour.

The variation in talk among college-educated parents is substantial

The average total daily word count for professional parents—parents who earned at least a bachelor’s degree from college—was significantly higher than for other parents. However, there was substantial variation in adult word count within all groups. In fact, the upper 50 percent of parents who did not complete high school had a significantly higher average daily word count than the lower 50 percent of parents who graduated from college ($t(79) = 4.07, p < .01$). (Figure 7)

[FIGURE 7]



High variability demonstrates opportunity for LENA users

One of the most important findings of the Infuture study is the high variability in adult words and conversational turns between families and within families.

Figure 7 above illustrates the high variability between families. Although, on average, college educated parents talk more to their children than parents without a high school education, there are many parents without a high school degree who talk more with their children than do the college educated parents.

With regard to within family variation, one method to measure variability is to calculate the coefficient of variation for the five or six 12-hour recordings for the 314 families in our normative sample. The coefficients of variation are the standard deviations in word counts and turns in the five or six recordings divided by their respective mean values. The LENA percentile norms indicate that the 50th percentile for average daily words is 11,124 words with a standard deviation of 4221 and a coefficient of variation of 38 percent. The 50th percentile mean for conversational turns is 504 with a standard deviation of 259 and a coefficient of variation of 51 percent. This means that approximately one-third of the time, a family who on average is at the 50th percentile could be either above the 80th percentile or below the 20th percentile.

Thus, day to day, the amount of adult words a child hears and the number of conversational turns a child engages in varies substantially in most families.

Both the high within family and between family variation in child language environment demonstrates that there is an opportunity for parents using LENA to significantly improve. The LENA feedback reports can help parents consistently provide more high word count days and fewer low word count days, which can in turn dramatically improve their child's cumulative language experience and accelerate their language and cognitive development.

Infoture discovered that most parents overestimated the amount they talked with their child

Infoture asked study participants to estimate the amount they talked to their children; 247 parents responded. Parents rated how much they thought they talked to their children on a 5-point scale: 1="not much"; 2="less than average"; 3="average"; 4="more than average"; 5= "much more than average". Virtually all parents—99 percent—thought they talked an average amount or an above-average amount. In fact, 75 percent of the parents thought they talked "more than average" or "much more than average". Of these parents who thought they talked more than average or much more than average, 51 percent were actually below the 50th percentile for adult word count. Only 29 percent of those who thought they talked much more than average were in the 80th percentile or better.

Infoture also looked at the differences between genders: is there a difference between the amount of language input that girls receive from their parents compared to boys? After all, it is widely known that girls are generally more advanced than boys in the early school years. As Hart and Risley learned and Infoture confirmed, there are distinct academic advantages for children whose parents talk more to them. Do girls hear more words in the crucial development years from birth to age three?

According to the Infoture study, that was the case. Mothers of girls tended to talk with their daughters more than mothers of boys talked with their sons. Up to age 30 months, mothers talked with their daughters 12.2 percent more than mothers talked with their sons. (Figure 8)

[FIGURE 8]

ADULT FEMALE VERSUS ADULT MALE WORD COUNTS DIRECTED TO
GIRLS AND BOYS (2 MONTHS – 30 MONTHS)

	DIRECTED TO	N	MEAN	% DIFFERENCE
ALL ADULT WORD COUNT	Girls	131	11,336	Overall girls hear 7.7% more words than boys
	Boys	121	10,526	
ADULT FEMALE WORD COUNT	Girls	131	8,982	Mothers talk 12.2% more to their daughters*
	Boys	121	8,003	
ADULT MALE WORD COUNT	Girls	131	2,354	Fathers talk 7.2% more to their sons
	Boys	121	2,523	

* The difference between adult female talk directed to girls versus boys is significant at the $p < .05$ level.

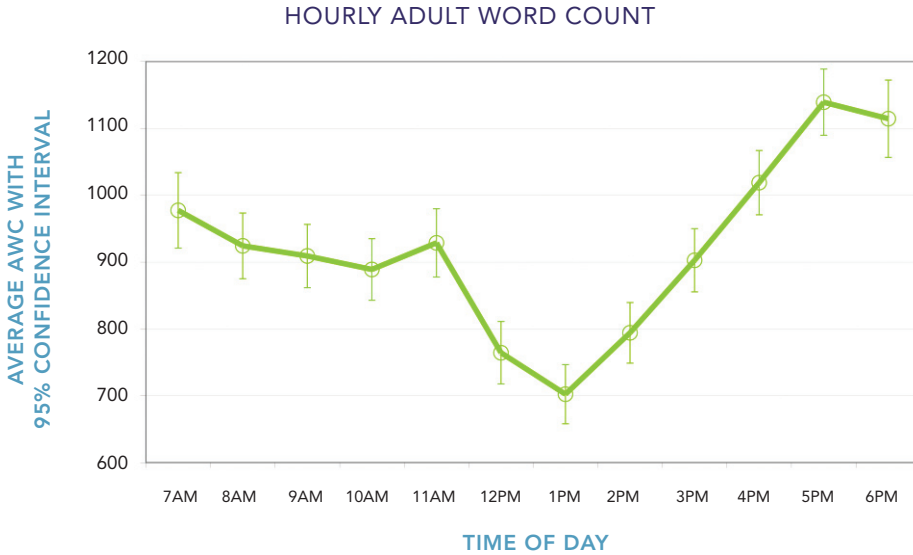
Fathers spoke substantially fewer words to their children than mothers did. Mothers spoke an average of 4,174 more words per day to their children, a difference that was more pronounced with daughters than with sons. Mothers contributed 78 percent of the total adult words spoken, while fathers contributed only 22 percent.²

Infoture also found that parents talked significantly more with firstborn children than with children who followed in the birth order. The average daily number of words spoken to firstborn children was 11,676, while the average daily number of words spoken to latter born children was 10,633—a difference of 9.8% ($t(312) = 2.20, p = .03$).

² Although Infoture has the technology to distinguish male and female voices, these measurements are reported as one aggregate number (Adult Words) in the first release of LENA. Subsequent software releases may include a more advanced index separating adult male and female word counts.

Most talk between parents and children aged two months to 36 months typically occurred at the end of the day. Conversation levels throughout the morning were relatively flat. The amount of talk plummeted in the early afternoon, presumably because children were eating or napping, and then rose until dinnertime. (Figure 9)

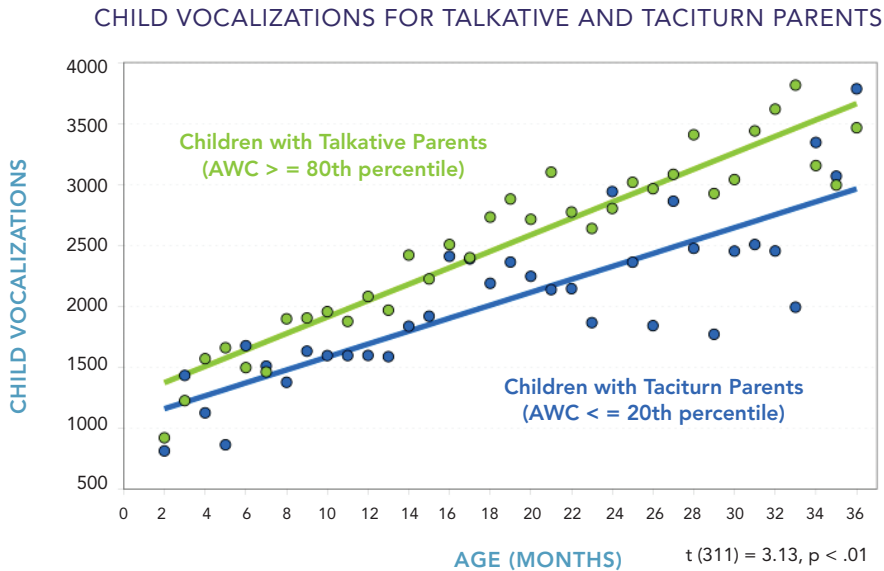
[FIGURE 9]



The biggest surprise from the timeline analysis was that there was not much talk during lunchtime. Conversation necessary for parents to get things done—business talk, as Hart and Risley described it—was the center of most lunchtime conversations. Naptime also reduced conversation levels.

Confirming results from Hart and Risley's longitudinal study, the Infoture study found that as children of talkative parents grow older, they vocalize more than children of taciturn parents. (Figure 10)

[FIGURE 10]



Whether parents were taciturn or talkative, the Infoture study showed that all children had similar vocalization levels at an early age. As time passed and language environment started to have an effect, children's vocalization rates became significantly different. This fact emphasizes the important role parents play as language teachers for their children.

The LENA daily adult word count estimates are lower than those projected by Hart and Risley. The estimated mean word count for Hart and Risley's college educated parents was 30,137 words per day, and the LENA 99th percentile is 20,943 words per day. Why are these counts different?

The difference between Hart and Risley's counts and the LENA counts can be attributed to data collection procedures. The participants in Hart and Risley's study did not record all day – they recorded for one hour, and that hour was extrapolated to a 14-hour day. Importantly, Hart and Risley's participants recorded in the afternoon and evening. As it turns out, the late afternoon and evening are peak talk times as shown in Figure 9 (page 16), something that Hart and Risley could not have known without LENA. Participants in the Infoture study recorded once a month for an entire 12-hour day; there was no extrapolation. The combined effect of these procedural differences means the LENA daily and hourly counts are approximately 30 percent lower than Hart and Risley's estimates.

This is actually good news. It means that each word a parent speaks to their child is 30 percent more powerful than what Hart and Risley estimated in 1995.

The study by Hart and Risley—recording one hour of conversation between parents and young children in 42 homes each month for three years—was truly groundbreaking in that it has caused educators, government officials, teachers, linguists, and parents to rethink language development for children from birth to three years old. Hart and Risley learned there was a direct correlation between adult words and a child’s IQ, adult words and a child’s academic success, and adult words and a child’s vocabulary learning trajectory. They also learned that families in the high socioeconomic status category talk more than families in other categories, but that the amount of talk between families varies tremendously—even among families in the high socioeconomic status category.

Using LENA to record conversations between parents and children in 314 homes over a 12-hour day for six to 11 months was equally groundbreaking.

Infoture confirmed the findings of the Hart and Risley study—the best thing parents can do for their children is talk with them. The LENA technology allowed Infoture to build on Hart and Risley’s seminal work, creating the first-ever percentile norms for daily adult word counts and conversational turns.

Additional interesting findings are that children hear more talk from their mothers than their fathers, and that mothers talk more to their daughters than to their sons. The analyses also revealed that parents talk more to firstborn children than to latter born children.

LENA’s ability to track adult words on an hourly basis enabled Infoture to learn that most talk between parents and their children occurred in the late afternoon and early evening.

Not surprisingly, children of talkative parents were equally talkative, and children of taciturn parents were just as taciturn. This finding reflects the important role parents play in their children’s language development.

So, for the parents who want to give their child the best chance of succeeding academically, the key is to talk to and with their child as much as possible.

Jill Gilkerson, Ph.D.

- Director of Child Language Research, Infoture
- Ph.D. from UCLA Department of Linguistics, concentrating in language acquisition
- Established and served as director of the UCLA Infant Language Lab

Dongxin Xu, Ph.D.

- Manager of Software and Language Engineering, Infoture
- Ph.D., University of Florida, Electrical and Computer Engineering
- BBN Technologies
- National Lab of Pattern Recognition, Beijing
- Research and engineering expertise includes signal processing, speech and speaker recognition, communication, pattern recognition, machine learning, and neural networks

Umit Yapanel, Ph.D.

- Speech Technology Engineer, Infoture, specializing in signal activity detection, speaker segmentation, speaker identification, and acoustic and language modeling
- Ph.D., University of Colorado, Boulder
- Interned at IBM's TJ Watson Research Center—Embedded Speech Recognition Group
- Developed robust speech recognition coefficients and a computationally efficient speaker normalization algorithm for embedded systems

Sharmistha Gray, Ph.D.

- Speech Technology Engineer, Infoture, specializing in analyzing children's speech, including pre-linguistic protophones, vegetative sounds, and fixed signals
- Ph.D., University of Colorado, Boulder—Speech, Language, and Hearing Sciences
- Awarded ten patents in speech recognition and telecommunication while working at Avaya

Jeffrey A. Richards, M.A.

- Statistician and Database Technician, Infoture
- Ph.D. candidate in clinical psychology, University of Colorado, Boulder
- Statistics and Research Methodology Laboratory Instructor, University of Colorado, Boulder
- Statistical Consultant, University of Colorado, Boulder

Charles R. Greenwood, Ph.D.

- Director and Senior Scientist, Juniper Gardens Children's Project, University of Kansas
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