Role of Sex in Rate of Infant Vocalization and Canonical Babbling

Janine Peca

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ROLE OF SEX IN RATE OF INFANT VOCALIZATION AND CANONICAL BABBLING

by

Janine Peca

A Thesis

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Master of Arts

Major: Speech-Language Pathology

The University of Memphis

May 2022
Acknowledgements

This work was supported by research grants R01 DC00484 and by R01 DC015108. No one involved in the project had any conflicts of interest regarding this work.
Abstract

A female language advantage has been widely reported, although it has not been consistently shown across the literature. Perhaps surprisingly, the possibility of sex differences in prelinguistic vocalizations in the first year has not been widely studied. A paper published in Current Biology in 2020 found that infant males produced a significantly larger number of speech-like vocalizations through 12 months of age than infant females based on human coding of randomly-selected samples from all-day recordings. The authors argued that their sampling method offered a maximally representative view of infant vocalization.

The present study also investigated possible sex differences in the first year, but the sample was much smaller than the prior one, and the data were collected in the much more limited circumstance of brief laboratory recordings where parents were instructed to interact with infants. Thus the new study offered the opportunity to shed new light on possible sex differences in early vocalization because the new study addressed a very different circumstance (parent-elicited vocalization in a brief laboratory recording) than the Current Biology study (naturally occurring vocalization in the home, all day long). Also the new study included data through 18 months, a point where infants are expected to be talking and where consequently we might imagine a female advantage in well-formed speech-like utterances to be discernible.

We hypothesized that the laboratory recordings might inspire girls to be more vocal than they would be all-day at home, nullifying any possible difference in amount of vocalization across the sexes as seen in the Current Biology paper. Further we considered the possibility that an advantage for girls might appear in the period from 12 to 18 months in the form of more speech-like utterances from girls than boys. The findings indicated no clear sex advantage in
amount of vocalization in the first 18 months of life, but provided tentative evidence of a female advantage in speech-like utterances in the period from 12 to 18 months.
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Background

Sex Effects on Language

Historically, a female language advantage in childhood has been widely reported. If correct, the reports suggest being female is protective against language disorder. In the literature, the effect of sex on language, however, has not always been statistically significant (Hyde & Linn, 1988). In fact, most studies have shown no statistically reliable effect of sex. When the effect has been statistically significant, it has typically been small and not necessarily consistent by age or type of language measure (Adani & Cepanec, 2019; Hyde & Linn, 1988; Leaper & Smith, 2004).

Looking for evidence of differences in prelinguistic vocalizations in the first year is challenging, as very young infants have rarely been investigated for sex differences in speech and language-precursors. An important exception is recent work published in Current Biology by Oller et al. (2020) who examined canonical babbling ratio (CBR) and rate of speech-like vocalizations (volubility) in 65 males and 35 females longitudinally over the first year of life. Canonical babbling refers to a stage in infant vocal development that “is characterized by syllables with at least one vowel-like element and one supraglottal consonant-like element with a rapid, adult-like formant transition between consonant and vowel” (Lang et al., 2019). Examples of canonical babbling are “ba” or “gaga.” Speech-like vocalizations (termed “protophones”) are defined as “functionally flexible non-cry precursors to speech” and include volitional vocalizations (Oller et al., 2019). Protophones include canonical babbling as well as vowel-like elements, consonant-like elements, growls, squeals, and raspberries, but not fixed signals (crying and laughter) or vegetative vocalizations (such as coughing and sneezing) (Oller, 2000).

Oller et al. (2020) obtained their data through all-day recordings using the Language
Environment Analysis (LENA) system. The data were collected through the Marcus Autism Center in Atlanta and were coded collaboration with the University of Memphis. Half the infants studied were at risk for autism (they had an older sibling with autism) and the other half were not. The data set for human coding consisted of 5-minute segments randomly-selected from the all-day LENA recordings in the infant’s home environment (Oller et al., 2020). Coders were not informed of the age, sex, SES, or risk group of the infants, although sometimes these variables were revealed in the course of listening to the recorded material. The results of the study indicated no significant sex difference in CBR across the first year. This is consistent with previous research on sex differences, a large portion of which has focused quality features of childhood language such as vocabulary knowledge or syntactic abilities; findings on sex differences have usually been either not statistically significant or significant with low effect sizes (typically Cohen’s $d < .2$) in favor of females (Adani & Cepanec, 2019; Hyde & Linn, 1988).

In terms of volubility, however, Oller et al. (2020) reported that male infants produced significantly more protophones than female infants ($p < 0.0001$, Cohen’s $d = 0.89$). In other words, the measurement of volubility was highly significant with an effect size much higher than has typically been reported in sex studies of language-related behaviors. In summary, in the Oller et al. (2020) study, there were no significant differences in the rate of canonical babbling of infant male and female protophones when measuring CBR. There was, however, a significant difference favoring the infant males in rate of protophone production. Of course, the study was not without its limitations. The numbers of infants were small once the groups were split into those at risk for autism and those not at risk. Half the participants came from the high risk for autism group and, as such, it was thought they could skew the data based on biological factors...
related to their risk and potential future diagnosis—but in fact boys produced statistically significantly more protophones in both the high and low risk groups. A major advantage of the method was the use of all-day LENA recordings, which allow a much more naturalistic view of infant vocal development than has been available from past research.

Oller et al. (2020) summarized their findings by emphasizing the distinction between quality of vocalization, as manifest in the degree of well-formedness of syllables produced by infants (reflected in CBR) and quantity of vocalization (reflected in volubility). It appeared to the authors that their study suggested baby boys are more talkative, producing a higher quantity of speech-like vocalization than baby girls, but that boys have no advantage over the girls in quality. Indeed if one could sample into the second year of life, perhaps girls would begin to show an advantage in the quality of their vocalizations, in the form of relatively higher CBR than boys.

**Role of Familial Factors in Sex Effects**

The research by Oller et al. (2020), produced in a collaboration between the Marcus Autism Center and the University of Memphis, suggests that protophone production is largely endogenous (Long et al., 2020). Put simply, infants tend to produce vocalizations without parental elicitation during the first year of life (Long et al., 2020). That is not to say parental interaction and elicitation are not valuable events in infant development, but until recently it was not realized that most infant vocalization is not responsive to parental engagement, but is generated instead by internal infant motivations.

Much research has focused on the role of familial factors and issues of possible sex differentiation in infant development. For example, in a study that did not include human coding of infant sounds, Johnson et al. (2014) examined parental input based on automated analysis of
all-day LENA audio recordings. It should be noted that human coding is the gold standard for evaluation of infant vocalizations, even in the case of all-day recordings. But LENA automated analysis affords the opportunity to evaluate much larger sample sizes. Considering 33 late preterm and full-term infants born at 34-41 weeks, Johnson et al. (2014) obtained LENA automated measures of adult word count, infant volubility, and number of parent-infant conversational turns for 10-hour recordings at three points in time: 1) with newborns still in the hospital, 2) at 44 weeks postmenstrual age (PMA), that is, the number of weeks since the first day of the mother’s last menstrual cycle prior to pregnancy, and 3) at 7 months of age corrected for prematurity. The second and third recordings were taken in the infant’s natural home environment when both parents were home.

Baby boys showed a nearly significantly higher ($p = .07$) level of volubility than baby girls at the second sampling point. Predictably, the study reported very significantly more female adult speech was heard by the babies at all ages than male adult speech. Further, adult female voices were identified more frequently during periods of infant female vocalizations than during periods of infant male vocalizations. Also there was a weak tendency for adult male voices to occur more frequently with infant male vocalizations.

Other potential factors that might interact with sex effects on language or language-related behaviors are number, age gap between siblings, and sex of the child’s siblings. Harvon et al. (2019) discussed the hypothesis that the more children in the family, the thinner the parental resources are spread. The researchers included adult models of language exposure among these resources. They, however, cited the confluence model proposed by Zajonc and Markus (1975) in which a child’s siblings are considered among the familial resources as they also provide language exposure. The researchers reviewed and provided additional evidence that
birth order can impact language outcomes in children (Harvon et al., 2019). As yet, such factors have not been considered extensively in research on vocal development in very young infants.

**Nature and Nurture in Sex Effects**

Biolinguist John Locke in *Duels and Duets* (2011) considered the different roles that distinguish how males and females tend to communicate. He portrayed males as duelers, who use language to impress and assert dominance (p. 4). Females, on the other hand, duet by communicating to build intimacy and work in concert with other speakers (p. 6-7). Locke’s portrayal invoked differences in language used by the sexes both in terms of nature and nurture.

Adani and Cepancec (2019), working from a primarily biological perspective, with discussion on the evolution of social roles, reviewed the literature on sex differences and language development, highlighting possible biological reasons for the differences. In existing biological literature cited by the authors, females have been viewed as holding roles specialized for social functions (management of the home, caregiving, etc.), while males have been viewed as tool-users, hunters, fighters, and so on, with less emphasis on social roles. A social role specialization of females has been documented in non-human primates as well (Adani and Cepancec, 2019). The authors argue this has led to speculation that the female brain was selected to be more responsive to social stimuli than the male brain. The potential social advantage of females may be amplified by a female advantage in fine motor skills (Adani and Cepancec, 2019). The authors imply that the presumed fine motor advantage of females might also apply to speech. The researchers additionally discuss the potential role of sex hormones in influencing brain development. For example, hemispheric lateralization, volume of brain region, patterns of neural activation, etc. can all be influenced by sex. As a result, the female brain has been thought to have become more optimally organized for language than the male brain.
The researchers also acknowledged that, although the body of research on sex and language often documents a female advantage, that the advantage is not consistently significant statistically (Adani and Cepancec, 2019). In the presentation of their argument, the researchers focused on the preponderance of males in the population of those diagnosed with speech and language disorders as evidence for the female advantage. If indeed females are relatively resistant to language disorders, it might help explain an apparent female language advantage. That said, this imbalance in language disorders by sex may produce a general problem of sampling, such that more males than females are excluded from samples. Hyde and Linn (1988) highlighted this potential imbalance, suggesting that failure to discern a female language advantage in many studies could be the result of biased sampling. Put another way, given that males are more likely than females to be diagnosed with a language disorder, excluding language disordered individuals from a sex and language study should attenuate findings of female advantage.

Summary of Research Body

The overall body of research on sex and language advantage provides inconsistent and confusing outcomes (Adani & Cepanec, 2019; Hyde & Linn, 1988; Leaper & Smith, 2004). Many researchers assume a female language advantage. However, in practice and in research, it is not consistently the case that females show a language advantage. It is also not the case that superior female performance on language evaluations, when it has been reported, has been consistently statistically significant. Researchers have additionally found that sex effects reported do not necessarily occur across all ages or language measures. Most of the research has focused on measures of language quality, for example measures related to how well individuals use syntax or how much vocabulary they command. The Oller et al. (2020) study, by contrast,
reported a male advantage in rate of protophone production, a sheer quantity measure where the only issue is how many protophones were produced within a given time frame. More research targeting both quality and quantity is warranted.

**Limitations of the Literature**

All studies on this topic are limited by the fact that there are too many features of language for any one study to cover them all. Language is massively multivariate. Aspects of language assessed, methods of study, sex biases in measures, and potential sex biases of the researchers or coders have the potential to affect outcomes in research on sex and language. Sample size, age of participants, cultural background, rearing practices, age, number of siblings, and preponderance of diagnosed language disorders in males, also potentially affect study results. Although some of the individual studies reviewed in the important meta-analyses (Hyde & Linn, 1988; Leaper & Smith, 2004) attempted to account for some of these variables, no study reviewed addressed them all. Overall, the current body of research does not offer strong support for a consistent, statistically significant female language advantage.

**Rationale**

A longitudinal dataset on infant vocal development, based on work by Oller and colleagues in the 1980s and 1990s in Miami, is now housed in the University of Memphis’s Origin of Language Laboratories and was made available for the present work. Numerous studies have already been published using the dataset, but it has never been examined for sex differences within the first year. In fact, an analysis on the data based on possible sex differences had never been considered while Oller was in Miami. After the Oller et al. (2020) article was published, however, it seemed important to look back at the Miami data. The present work offers an analysis of these more than 30-year-old data, which were collected in a different setting, but
promise to offer a novel viewpoint on possible sex differences in the first year of life.

Unlike the Oller et al. (2020) effort, where the audio samples were obtained from all-day recordings at home, the infant vocalizations for the Miami study were elicited for audio recording in a laboratory setting. Possible sex effects on both volubility (protophones per minute, excluding cries, laughs, and vegetative sounds) and CBR (number of canonical syllables divided by number of all syllables) can be calculated from the dataset from 4-18 months of age on 46 infants (28 male, 18 female). The goal of this study is to shed new light on Oller et al. (2020)’s finding of higher male than female volubility by considering the Miami data, based on laboratory recordings where infants were being engaged vocally by a parent rather than on home recordings where parents only occasionally engaged the infant in vocal interaction.

**Hypotheses**

1) It is clear that canonical babbling increases with age throughout the first year (Eilers et al., 1994; Eilers et al., 1993), a fact that corresponds to infants’ growing inclination and ability to produce syllables that are adapted for speech. We predict that canonical babbling ratio (CBR) will increase with age for both sexes. 2) Based on the body of research that suggests females have a slight language advantage, we predict that female infants will have higher CBR, especially at later ages (Adani & Cepanec, 2019; Hyde & Linn, 1988). 3) In the Oller et al. (2020) study, male infants were shown to have higher Volubility (we capitalize this term when referring to the formal dependent variable for our analyses). We predict male infants will have higher Volubility relative to female infants.

**Methods**

**Participants**

As part of a series of studies at the University of Miami in the 1980s and 1990s, the
infants to be considered here were followed longitudinally from 4 to 18 months of age (Eilers et al., 1993; Eilers & Oller, 1994; Oller et al. 1994; Lynch et al. 1995). The participants to be considered included 28 males and 18 females born at term. The infants had been recruited through mailings to families based on recorded births at the end of the infants’ first month of life. Respondents were interviewed by phone and in an initial face-to-face meeting to acquire consent for participation in the study and for verification that the infants had no clinical diagnoses and had shown no significant birth anomalies. The papers cited above offer considerable additional information about the subject group and its recruitment.

**Recording Procedures and Utterance Selection**

Recordings to be considered here were made at 4, 6, 8, 10, 12, 16, and 18 months of age. Each recording session took place in a 6.5’x 6.5’ sound-treated room with the infant, accompanying family members (usually just the mother), and a staff member. The sessions lasted 20-30 minutes. Recording procedures included provisions for rescheduling if: 1) the accompanying family did not believe the infant’s vocalization to be representative of the infant’s vocalizations at home, 2) a 50 protophones minimum had not been reached, or 3) the infant was not in a period of wakefulness (sometimes sessions were postponed until the infant was finished napping) (Eilers et al., 1993).

Of note, the coding procedures and coder training were very similar for the Miami dataset and for the set used in the Oller et al. 2020 study, mainly because the training of coders in both cases was conducted by Oller in accord with definitions and a theoretical perspective developed previously (Oller, 1986) and extensively explored in Oller (2000).

**Coding Procedures**

Coders listened to recordings to which they had been assigned from the beginning,
keeping a record of how many “utterances” they had categorized as they went. The term utterance was used to refer to a phonatory breath-group, that is the period of vocalization that occurred on a single exhalation (Lynch et al., 1995). The term “protophones” refers to all infant utterances that can be distinguished from cries, laughs, or vegetative sounds. More detail on these definitions is provided in Lynch et al. (1995) and Oller (2000). The coders were instructed to stop coding at 70-utterances for each session or before that if the infant did not reach 70-utterances (Steffens & Oller, 1992). An average of 69 utterances were coded across the 341 recordings used. Actually, 4% of the recordings were coded beyond the point of 70 utterances. The highest utterance count used in the present study was 81. Also, 7% of the recordings contained fewer than 70 utterances. The lowest utterance count used in the present study was 30.

The decision to code and analyze utterances from the beginning of each session and not to go beyond 70 was a practical one, intended to make the sample relatively uniform across infants and ages and to restrict coding time because of funding limitations.

**Coding Categories and Measures for Analysis**

In accord with the standard procedures used by Oller and colleagues since the 1980’s, infant utterances were categorized distinguishing vegetative sounds (coughs, sneezes, etc.) and fixed signals (cries and laughs) from protophones, the presumable precursors to speech (Oller et al., 1976; Oller, 1986). Only the protophones were counted in the determination of Volubility.

Each protophone could consist of one or more syllables, where syllables were defined as audible rhythmic beats, a concept that applies both to canonical (baba, dadi, etc.) and non-canonical (e.g., any sequence of vowels only, raspberries, squeals, growls, etc.) utterances. The coders were required to indicate the number of canonical and non-canonical syllables in each utterance/protophone.
The number of utterances per minute (protophones only) up to the point where the coder stopped was treated as the Volubility measure. The number of canonical syllables across the coded session was divided by the total number of syllables (canonical syllables / (canonical + non-canonical syllables)) to yield the CBR for each session. Three recorded samples were excluded from the set used in the analysis because of particularly low utterance count.

**Coder Reliability**

The protophones of human infants include considerable variability on acoustic parameters, from duration to amplitude to pitch to spectral properties, but their variability does not prevent them from being identifiable by adult listeners as precursors to spoken language in contrast with fixed signals such as crying and laughter, or vegetative sounds such as coughing, burping or grunting (the kind that occurs with physical straining). When canonical babbling begins in the middle of the first year (Oller, 1980), parents immediately recognize that the protophones are beginning to be even more like speech, and they often begin to try to shape the infant’s usage of those vocal patterns to make them into words (Papoušek, 1994). For example, a parent hearing the baby saying “baba” might direct the infant to a “bottle”, saying “yes, baba is bottle.” If the protophones were not identifiable this way, parents would not be able to make use of them in assessing infant preparedness for learning to talk. Parents who failed to be able to assess infants in this way would surely be naturally selected out of the population because they would not be able to consistently and usefully respond to their infants’ vocal learning. Consequently, Oller has long argued that coding of infant vocalizations to obtain measures of Volubility and CBR is based on an inherent human ability for recognition of infant progress toward speech. Training thus requires primarily bringing a tacit awareness of human adults to conscious awareness. Thus the training of coders in the Oller laboratories has always been an
effort designed to bring conscious awareness to knowledge that exists naturally in all typical humans, and to give names to the vocal categories of infancy that adult awareness recognizes.

However, Oller’s method does not seek to enforce strict agreement during training about the categorization of all sounds, because, in spite of the broad recognizability of infant sounds, there are also inherent ambiguities in the sounds babies produce. So the careful training of coders focuses on the terminology of coding, so that trainees can learn to speak clearly about the nature of their decisions, for example, to explain why they think a particular fussy sound should be treated as a cry rather than a protophone).

Measures to maintain coder reliability for the Miami data were taken during the coder training period and intermittently during the study as documented in the Miami studies cited above. After an intensive initial period of training for new coders on the relevant terminology, usually lasting three months, using recorded examples of infant utterances, all coders participated in independent coding of real recordings of infants not used as data for the study. They were required to meet a criterion of no more than a 10% discrepancy from the values obtained from gold standard coding of the same recordings (a consensus coding by Oller and other senior coders of the Miami team at the time) on the key parameters (Volubility and CBR) before they were allowed to go on to official data collection coding. Coders who did not meet the criterion after the first round of training were required to go through an additional round and meet the criterion. The training procedure for this particular data set was first described in formal publication in Steffens & Oller (1992).

Analysis

After all the data were coded, analysis was conducted with Generalized Estimating Equations (GEE) (Liang & Zeger, 1986), a method yielding a conservative estimate of statistical
significance relative to traditional mixed models analyses. One advantage of the GEE is that it
takes account of correlations within each infant’s longitudinal data. The GEE also has the
advantage of not requiring the assumption of normality of distributions inherent in parametric
models. Our GEE model was linear, and accounted for missing data, which were common.

The primary analysis evaluated Sex and Age (8 levels) as fixed factors and Infants as a
random factor. The dependent variable for the first analysis was Volubility in utterances (or
protophones) per minute, and for the second analysis it was CBR.

Results

On the first hypothesis, the data (Figure 1) showed a clear pattern of growth in CBR
across Age for both the boys and the girls. This Age effect was highly statistically significant
($p < .00001$) based on the GEE results, as expected, even in the context of a significant
interaction of Sex and Age ($p = .025$). The size of the effect was huge; from 4 to 18 mo the
difference in CBR was .449 (Cohen’s $d = 5.11$), and even from 12 to 18 mo, the difference in
CBR was .132 (Cohen’s $d = 1.03$). Figure 1 provides the data on CBR, and as can be seen, the
girls showed growth in CBR across Age to a greater extent than the boys, an effect that confirms
our second hypothesis. By the 18 mo sample, the girls’ average CBR was .154 higher than the
boys’ (Cohen’s $d = .888$); the girls’ CBR revealed that more than half their syllables at 18 mo
were canonical (CBR = .552). The higher CBRs of the girls also contributed to a nearly
significant effect of Sex ($p = .063$, CBR diff = .045, Cohen’s $d = .381$).

In Figure 2, we see the results with regard to Volubility. No significant main effects or
interactions of Sex and Age were found, disconfirming the third hypothesis, and thus failing to
reveal the pattern of volubility seen in Oller et al. (2020). Figure 2 hints at a male advantage at
12 and 14 months (the error bars are 95% confidence intervals), but the GEE model did not
support the apparent difference. The Volubility levels (~6 protophones/min) did not change significantly across Age for either boys or girls, and these levels are comparable to those reported in other recent research evaluating parent-infant interaction in laboratory recordings during the first year of life (Iyer et al., 2016; Oller et al. 2021). The present study offers data into the second half year of life, data not offered by the previous works. While Volubility decreased across ages in these laboratory samples of infant vocalization for both the prior studies and the present one (though not significantly in the present one), the second half-year showed an increase in Volubility for both boys (increase of 1.61 protophones/min, Cohen’s $d = .644$) and girls (increase of 1.69 protophones/min, Cohen’s $d = .662$).

**CBR vs. Age**

Figure 1: Volubility vs. Age

Figure 1: CBR increased across Age for both sexes. The boys and girls showed similar CBRs at the younger ages, but the girls showed greater growth in CBR than the boys. The error bars represent 95% confidence intervals.
Volubility vs. Age

Figure 2: Volubility vs. Age

Figure 2: Volubility was relatively stable for both boys and girls across ages. Boys and girls did not differ significantly. The error bars represent 95% confidence intervals.

Discussion

The present study based on the Miami data offers new perspectives on the results of Oller et al. (2020), although it is emphatically not an attempted replication. Instead it offers a new view of possible sex effects in both infant volatility and canonical babbling ratio (CBR), because the recording procedure was vastly different from that of Oller et al. (2020), and there were other notable methodological differences from the prior work. One key difference is that the present work accessed data from 4-18 months of age, while Oller et al. (2020) addressed only the first 12 months of life.

The most notable finding here was the significant interaction of Age by Sex for CBR. The girls, as predicted, exceeded boys in CBR, but only in the second year of life. The difference was not only significant, but by 18 mo the effect was quite large ($d = 0.888$), 4-5 times larger than typically reported female language advantage in the hundreds of studies of the past (Hyde &
Linn, 1988; Leaper & Smith, 2004). The CBR of girls by 18 months indicated more than half their syllables (.55) were canonical, a fact that may have reflected common usage of real words by the girls, while boys at the same age had CBRs of about .4. It is widely reported that girls have larger vocabulary than boys in this age range (Galsworthy et al., 2000; Bornstein et al., 2004), so we think it reasonable to suspect that greater usage of real words by girls may have played a role in the CBR difference.

The present study did not, however, produce significant findings for Volubility. We do not view this as a contradiction of the Oller et al. (2020) study in which male infants demonstrated significantly higher Volubility than infant females, but rather as an addition to it. In the circumstance of random-sampling across all-day recordings, the prior work provided both highly significant findings ($p < .0001$) and also a large effect size ($d = 0.89$). The failure to find the same pattern here, suggests that observing higher Volubility of males infants may indeed depend on all-day sampling, or more generally on sampling that does not involve constant presence and attention from caregivers, as occurred in the present research. Our favored interpretation of the failure to observe higher volubility in male infants in the present study is based on the supposition that female infants may be more socially-inclined and more responsive to caregiver attention. This tendency may yield somewhat higher volubility in female infants in the laboratory environment with caregivers always present and engaged in vocal elicitation than would be expected for all-day recordings, where caregivers engage far less often in face-to-face elicitation. It may be important also to note that even though the differences were not statistically reliable, the males did show higher Volubility than females at an effect size of $d = 0.11$ in the first 12 months.

Other differences between the present study and that of Oller et al. (2020) may also have
played roles in the comparative outcomes. 1) The laboratory in which the present study’s recordings were taken was small and a parent and a researcher (a stranger) were always present. For Oller et al. (2020) usually there were only family members present. Perhaps baby girls and boys reacted differently to the tight space of the laboratory or the presence of a stranger.

2) While parental attempted elicitation of infant vocalization occurred throughout the Miami recordings, prior work with the LENA recordings of Oller et al. (2020), indicates that parental elicitation was only intermittent in the home recordings, and that infants rarely responded vocally to parent-directed speech at home. These facts suggest again that the failure to find a Volubility difference by sex in the Miami data may reflect greater responsivity to parental attention by girls, offsetting the tendency that otherwise might show boys being more voluble.

3) The present study had a significantly smaller sample size than Oller et al. (2020), where more than twice as many infants were involved, 21 times more protophones were coded and analyzed, and 131 times more recorded material. The smaller sample size of the present work may have limited the power to detect sex differences in Volubility in the Miami data.

4) The microphones used in the Miami work were not worn by the infants and varied in distance from the infant’s mouth by typically 2-3 feet. By contrast, the microphones of the LENA recorders, which are worn by the infants in a vest were nominally 4 to 6 inches from the infant’s mouth, yielding a better signal to noise ratio. This better sound quality may have allowed more consistent coding in the Oller et al. (2020) work, with conceivably better power to detect differences between the sexes.

5) The coding procedure in Miami was one where multiple listening opportunities were available for each utterance, a procedure called “repeat listening.” In the Oller et al. (2020) data, coding was done in real-time, with no stopping of the playbacks. It is not obvious whether there
is any advantage for the purposes of determining Volubility or CBR based on real-time vs. repeat-listening coding (Patten et al. 2014).

6) In the Miami study, coders were instructed to stop coding for each session once the infant reached 70 utterances, unless the infant did not produce 70 utterances. By contrast, Oller et al. (2020) coders were instructed to code the entirety of 21 randomly-selected 5-minute samples from each all-day recording. It seems possible that baby boys and baby girls might differ in how quickly they become comfortable and responsive in the laboratory setting. Perhaps girls, being more sociable, become comfortable more quickly and thus produce higher Volubility relative to boys than one would expect after the point of 70 utterances in the recordings. The first 70 utterances in a laboratory setting cannot be expected to be representative of infant vocalizations in general, while coding randomly-selected segments of recordings would appear to be ideally representative.

The most intriguing possibility to explain the lack of a sex differences on Volubility in the present study (assuming that Oller et al. 2020’s result on sex differentiation of Volubility in all-day recordings is generalizable) would appear to be based on female infants’ conceivably reacting more communicatively (and with relatively more vocalization in the situation of a very short-term interaction in a small laboratory) than they would during all-day recordings.

Clinical Implications

Importantly, clinicians need to be informed of the complexity of findings regarding sex and language. The simple conclusion that girls are better than boys at language is not reasonable. Also clinicians should be careful not to assume that an infant’s sex is protective against all language delays or disorders. Some disorders afflict males more than females and for some the reverse is true. Stuttering and autism, for example, are male-dominated cases. Furthermore, it is
important for clinicians to realize that in the cases where significant results have been obtained, favoring either boys or girls on some language-related matter, the effect sizes have tended to be small to very small. The implication is that there is a great deal of overlap in the distributions of language tendencies in boys and girls, and only a small extent to which differences favor one sex over the other.

The present study only offers a hint about possible important differences between boys and girls in vocal development of the first 18 months. That difference is the tendency we observed for girls to use advanced babbling (canonical babbling) more than boys in the second half year of life.
References


