

November 23, 2007

Mark Liberman, Director  
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Dear Professor Liberman,

This letter addresses your comments regarding my discussion of differences in **hearing**. The substance of most of your comments online (e.g. <http://itre.cis.upenn.edu/~myl/language/og/archives/003487.html>) are directed not at either of my books, but at a web page which I wrote hastily almost three years ago (<http://www.genderdifferences.org/hearing.htm>). Your criticism regarding my discussion of one of the papers cited on that web page (Singinger, Cone-Wesson, and Abdala, 1998) is accurate, and the errors you point out have long since been corrected, but you have never updated your posts. Many of your most hostile comments, particularly about differences in hearing, would be difficult for a careful reader today to understand, because you are attacking comments which haven't been on any web page of mine in a long time. I do plead guilty to the crime of posting material online without adequate fact-checking. I would ask that you focus your attention on my books and on the web postings I have made in the past two years, as I am now much more cautious about what I put on the web. I should have exercised more care when I first started posting comments on the web; you are quite right in this regard.

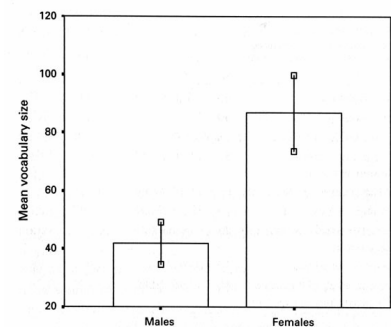
You show no awareness of new research suggesting that young men and young women may indeed subjectively assess loudness quite differently. I have attached a recent paper making this point (Sagi, D'Allesandro, & Norwich, 2007; copy enclosed). You are selective in the research you cite, using only those papers which support your position. While such selectivity may perhaps be justified when writing a popular book for a lay audience, with severe constraints on length, it is harder to justify such selectivity when writing a scholarly post online.

If we are going to engage in a scholarly discussion of sex differences in hearing, the first point to emphasize is that sex differences in the brainstem and neocortical responses to auditory stimuli are very much a function of the type of stimulus. For passive listening to natural language, sex differences are large. For non-verbal stimuli, such as a click or a buzz or a tone, sex differences are smaller. This one fact is key in making sense of the otherwise divergent and confusing literature on sex differences in auditory processing. Kansaku and Kitazawa make this point in their review published in *Neuroscience Research*, volume 41, pp. 333-337, 2001; copy enclosed.

Another important point in the original version of chapter 2, which did not survive into the published version, is the relevance of the pitch of the tone which is being assessed. Sex differences in the perception of pure tones are small or non-existent at low pitches, e.g. 200 Hz or 400 Hz. However, sex differences are more significant at high frequencies such as 8000 Hz.

Discrimination of high pitches is crucial in distinguishing e.g. the words "like" and "light." If you examine the power spectra of these two words, you will find that they are the same -- at low frequencies such as 200 Hz and 400 Hz. The words "like" and "light" differ only in the high frequencies, 4000 Hz and above. The typical 18-month-old girl would easily distinguish these two words and therefore could be expected to learn their distinct meanings quickly. The typical 18-month-old boy has less acute hearing in this range. For the 18-month-old boy, the distinction between the words "like" and "light" would be less obvious, less salient, because he's not hearing quite as well in that range.

This difference in auditory acuity may help to explain the difference in vocabulary at this age. The average 18-month-old girl has a vocabulary of about 90 words, compared to about 40 words for the average 18-month-old boy. While the Cambridge University researchers who documented this finding (shown below right) believe that sex differences in the language processing areas of the brain, rather than in the peripheral auditory apparatus, are chiefly responsible for this difference, I think that these differences may derive both from peripheral differences (e.g. sex differences in the packing density of outer hair cells on the basilar membrane), as well as sex differences in the brain itself (which the group at Cambridge University has chosen to emphasize).



Sex differences in vocabulary, for 18-month-old toddlers

On your page attacking the way in which I presented sex differences in auditory processing (I am referring to <http://itre.cis.upenn.edu/~myl/language-log/archives/003487.html>), you neglect to mention that I cited THREE studies documenting these sex differences (*Why Gender Matters*, reference 13 for chapter 2, p. 279):

1. Cone-Wesson & Ramirez, 1997;
2. Sininger, Cone-Wesson, and Abdala, 1998
3. Chiarenza, D'Ambrosio, and Cazzullo, 1988

The findings in the first and third references suggest that girls have lower thresholds (as measured by ABR) than boys have, at higher frequencies. The second reference -- Sininger, Cone-Wesson, and Abdala -- does not show the same finding, but instead shows mostly an overlap in thresholds. I wrote to Barbara Cone-Wesson in 2004, while preparing chapter 2 of *Why Gender Matters*, asking her to explain why her paper with Ramirez showed a result so different from the result with Sininger, Cone-Wesson, and Abdala, but she declined to respond, saying that she was too busy. You discuss only Sininger, Cone-Wesson, and Abdala.

More fundamentally, your online comments fail to engage the central point of chapter 2 of *Why Gender Matters*; you choose instead to emphasize errors and omissions in my presentation of the published research. The central point of chapter 2 has to do with the empirical findings suggesting that boys do not hear as well as girls. In chapter 2 of *Why Gender Matters*, I cite two scholarly articles, both published by researchers at Florida State University, which showed that playing soft lullabies helps premature girls quite dramatically, but didn't help premature boys at

all.<sup>1</sup> You never mention those studies of premature babies. If the different outcomes which those investigators reported are not due to differences in auditory acuity, then how would you explain them? The Cambridge group presents data suggesting that the average 18-month-old girl has a comprehended vocabulary of about 90 words, compared with about 40 words for the average 18-month-old boy. If those differences are not due to sex differences in auditory acuity (as I suggest) or to sex differences in the brain itself (as the Cambridge group believes, but which you would also presumably dispute), then how would you explain these findings?

Perhaps, as you argue, sex differences in auditory acuity are too small to have any functional significance. In that case, we need some other hypothesis to account for the findings mentioned above, e.g. that 18-month-old girls have substantially larger vocabulary than 18-month-old boys, and that soft music has dramatic beneficial effects for premature baby girls but not for premature baby boys. Or, you could dispute those empirical findings. But merely rejecting the hypothesis of differential auditory acuity, while failing to offer any alternative hypothesis, leaves your argument incomplete.

Perhaps the true explanation has nothing to do with sex differences in auditory acuity. Recent research has demonstrated profound differences in the trajectories of brain development. In some brain regions, boys lag behind girls by as much as four years, on average, with no overlap between the trajectories of girls and boys (see Lenroot, Gogtay, Greenstein, et al., 2007, especially figure 2, p. 1068; copy enclosed). **It is entirely possible that the sex differences we observe – e.g. in the pace of vocabulary acquisition, or in the effectiveness of music therapy for premature newborns – are not due to sex differences in auditory acuity, but to sex differences in the pace of brain development** or to some other factor. The best way to determine the truth, I believe, is not to engage in a politically-charged exchange of insults, but rather to consider all the relevant research as dispassionately as possible. I hope you will consider modifying your web postings accordingly.

Sincerely,

Leonard Sax, MD, PhD

Enclosures:

1. Berninger, 2007
2. Lenroot, Gogtay, Greenstein, et al., 2007
3. Sagi, D'Alessandro, & Norwich, 2007
4. Kansaku & Kitazawa, 2001

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<sup>1</sup> More specifically: Jayne Standley (1997) specifically noted the dramatic sex differences in her results. Although Janel Caine (1991) did not report sex differences in the published version of her article, her original data demonstrated the same dramatic sex differences, as Standley pointed out and as a quick review of Caine's own thesis, available on request from the FSU library, easily confirms.