**Online supporting information for**

**“The more, the better? Behavioral and neural correlates of frequent and infrequent vowel exposure**”

***Additional analyses of data reported in Experiment 2***

Motivation and Method

Although the planned analyses reported in the main article revealed no difference between the frequent and infrequent conditions, inspection of the curves in Figure 4 suggested to us that there may be slight differences in the infants’ brain response in terms of the timing of the hemodynamic response. We followed up on this post-hoc observation through additional statistical analyses. For this purpose, we used a GLM where stimulation was represented by the FIR convolved with 20 one-second boxcar regressors progressively time-shifted by 1 s from stimulus onset, and this separately for the frequent and the infrequent condition. Notice that the main analysis assumes a GLM, so as to take into account baseline changes following artifacts and slow trends, and can be viewed as being more akin to averages. It does not, in this shape, allow the inspection of a detailed time course. Therefore, we fit a different GLM to each individual infant’s data, where the key regressors were a series of FIRs convolved with a 1-second stimulation, and timed at 1, 2, … 34, and 35 seconds from the onset of alternating trials; this was done for oxyHb and deoxyHb separately, and for the frequent and infrequent blocks separately. This allowed us to describe separately two aspects of the hemodynamic response to the change blocks, namely the amplitude and latency of the response peak during the stimulation (i.e., between 0 and 20 s after the onset of the change block). The **peak amplitude** was defined as the numeric maximum concentration per hemisphere and condition, averaged across the ROI channels for every infant separately. Accordingly, the **peak latency** reflected the time at which that peak amplitude occurred per hemisphere and condition, first calculated separately for each of the 3 channels within the ROI, and then averaged across the ROI channels, and all of this carried out on the individual infants’ data.

Results

Two separate linear mixed effect model analyses were conducted for the amplitude and latencies, declaring hemisphere and condition as main effects, and allowing both intercept and slope to vary across the random variable infant. In the analysis on peak amplitudes, the intercept was significant (*t*(372)= 9.684, p <.001), indicating that there was an overall difference in peak amplitudes between non-alternating and alternating trials. The effect of hemisphere was marginally significant (*χ2*(1) = 3.46, *p* = .063), due to a higher peak amplitude in the left (*m* = 0.098, *SD* = 0.086) than the right (*m* = 0.085, *SD* = 0.077) hemisphere. No other effects approached significance (condition: *χ2*(1) = 0.011, *p* = .917; condition x hemisphere: *χ2*(1) = 2.63, *p* = .105). This analysis thus simply replicates the main findings from the planned analyses.

In the analysis on peak latencies, a significant main effect of condition was obtained (*χ2* = 6.62, *p* = .010), reflecting a later peak latency in the infrequent (*m* = 12.90 s, *SD* = 5.84) compared to the frequent (*m* = 10.96 s, *SD* = 5.97) condition. In addition, the interaction between condition and hemisphere was marginally significant (*χ2* = 3.71, *p* = .054), due to a slightly faster response in the right than in the left hemisphere in the frequent condition (right *m* = 10.80, *SD* = 5.98; left *m* = 11.15, *SD* = 5.98), whereas the opposite is true for the infrequent condition (right *m* = 13.71, *SD* = 5.91; left *m* = 11.90, *SD* = 5.63). The main effect of hemisphere was not significant (*χ2* = 2.07, *p* = .150).

Discussion

Our post-hoc analysis revealed a difference in peak latency between conditions. Peak latencies have not been a standard measure in the infant NIRS literature on language development. They have however been discussed as a potential measure of processing speed (Arimitsu et al., 2011) based on a non-significant tendency of a later peak in a prosodic compared to a phonemic condition. In another recent study, a median split of infants that had high-volume and low-volume hemodynamic responses to both spoken sentences and musical phrases found that high responders were also faster responders (Fava, Hull, Baumbauer, & Bortfeld, 2014). The authors suggest that high-volume responses were related to more mature underlying processing mechanisms. Finally, a study comparing preterm infants at a matched maturational age to fullterm infants in terms of their hemodynamic response to continuous speech showed shorter response latencies in bilateral temporal cortices in preterm infants (Nishida et al., 2006). These results were argued to possibly reflect their longer exposure to broadcast speech. In this context, the present results might indicate that infants can discriminate both types of contrast equally well, but process the frequent contrast faster than the infrequent one. Notice that this interpretation is not incompatible with the idea that infants’ discrimination per se does not benefit from exposure beyond a critical minimum, as it could still be the case that there are differences in processing speed with frequency that are not accompanied by greater sensitivity to the sound contrast.

In addition, the post-hoc analyses suggested a tendency for higher activation in the left compared to the right hemisphere. Such differences are thought to be indicative of linguistic processing, namely left lateralization. Given infants’ higher amount of exposure to the frequent compared to the infrequent contrast, it is not inconceivable that left-lateralization would be stronger in response to the frequent contrast. However, previous NIRS studies have reported left-dominance in response to vowel stimuli in slightly older age-groups, namely from 7-8 months (Minagawa-Kawai, Naoi, Nishijima, Kojima, & Dupoux., 2007) or from 11-12 months (Sato, Mori, Furuya, Hayashi, Minagawa-Kawai, & Koizumi., 2003) onwards. Testing older infants would show us whether the unexpected result we observe, namely that the infrequent contrast had greater response amplitude on the left hemisphere than the frequent contrast, is merely transitory.

**References**

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