Detection in the presence of continuous vs. pulsed random maskers

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The detectability of a tone added to a noise masker improves when the noise begins before the signal and ends after the signal (e.g., Yost, 1985). For long-duration maskers, increasing temporal uncertainty regarding the time of the signal causes slight increases in thresholds (e.g., Egan *et al*., 1961).

The conditions in this experiment parallel those previously tested for tone-in-noise tasks, except (a) the maskers are more variable than noise maskers, and (b) the signal to be detected forms a “stream” against the highly variable masker.

Because the masker is extremely variable the expectations were:
1. That pre- and post-exposure to the masker would **not** aid listeners in detection. The masker “fringes” do not provide a stable estimate of masker energy against which the onset of a signal could be detected.

2. It seemed likely that effects of signal uncertainty would be large. Against this prediction, however, is the possibility that the “streaming” nature of the signal would counter effects of signal uncertainty.

Experiment

The signal to be detected was a sequence of three contiguous, 60-ms, 1000-Hz tones. The signal levels were randomly drawn from a 10-dB.

The two maskers tested had similar long-term spectra but different short-term spectra:

***Pink Noise**:* Band limited to range from 200-5000 Hz.
***Random Multi-burst**:* 60-ms bursts, each burst being composed of, on average, 20 tone pips with frequencies drawn between 200 and 5000 Hz on a logarithmic scale

The masker levels were, on average, 63 dB SPL.

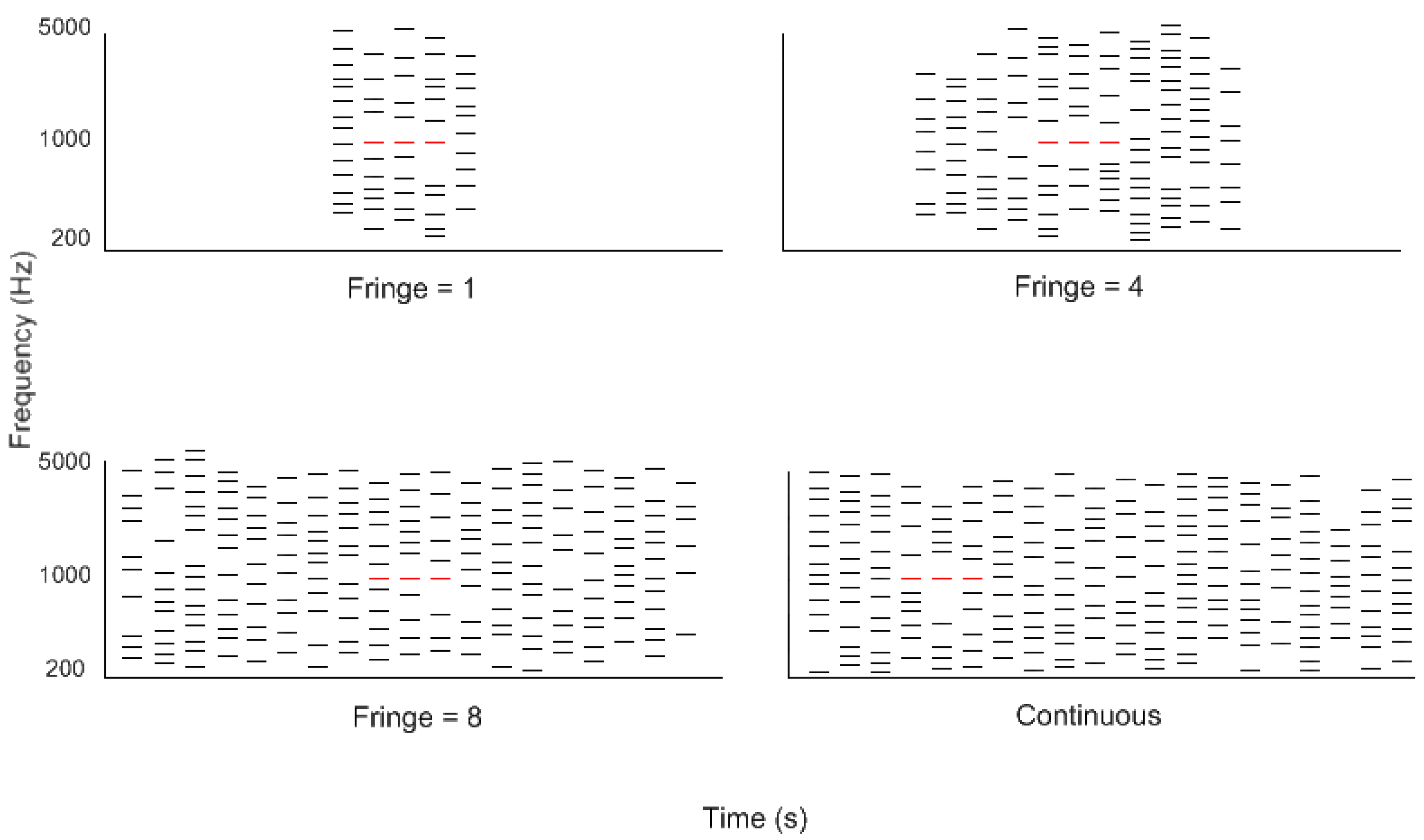

Figure 1

Two conditions were tested:

***Continuous**:* The masker was presented continuously for approximately 5 minutes.
***Fringe**:* The masker was turned on before the signal onset and turned off after the signal offset. The number of “fringe” bursts (or the duration of the Pink noise, 60 ms times this value) preceding and following the signal was 1, 4, or 8. In other ways the timing of the stimulus presentation was as in the continuous condition.

Figure 1 shows the Random Multi-Burst masker for the Fringe and Continuous conditions.

In the continuous condition the signal occurred at random times. In the fringe conditions, however, the signal’s temporal position was reliably indicated by the masker onset. This temporal reliability was emphasized by blocking the conditions, and by informing the subjects of the manipulation.

Results:

Figure 2 shows thresholds for individual subjects using different colors.

The Random Multi-burst masker (solid lines) is a more effective masker than the Pink Noise masker (dashed lines).

For S3 (red) thresholds are the same independent of the number of fringe bursts / fringe duration and whether the presentations is continuous vs. pulsed (fringe conditions). This is true for both Noise and Multi-burst masker types.

For S1 and S2, for the Noise masker thresholds are slightly higher with a 60-ms fringe (Fringe =1) than for the continuous presentation.

For S1 and S2, for the Multi-burst masker thresholds are much higher with one fringe burst than any other conditions, including continuous.

For all three subjects, with the Multi-burst masker, thresholds are approximately equal for fringe values of 4, 8, and the continuous masker. This suggests either (a) a perfect balance between temporal uncertainty (from fringe to continuous) and continued benefits of increasing fringe durations, or (b) no effect of temporal uncertainty and no improvement for fringes beyond 4 bursts. The latter seems the more plausible conclusion.

Discussion

Contrary to our expectations, increasing the fringe duration beyond 1 burst increased sensitivity for 2 of the 3 subjects. For the detection of a tone added to noise, fringe effects are thought to reflect an opportunity to compare informational over time, allowing the detection of an increment in the energy in the signal channel.

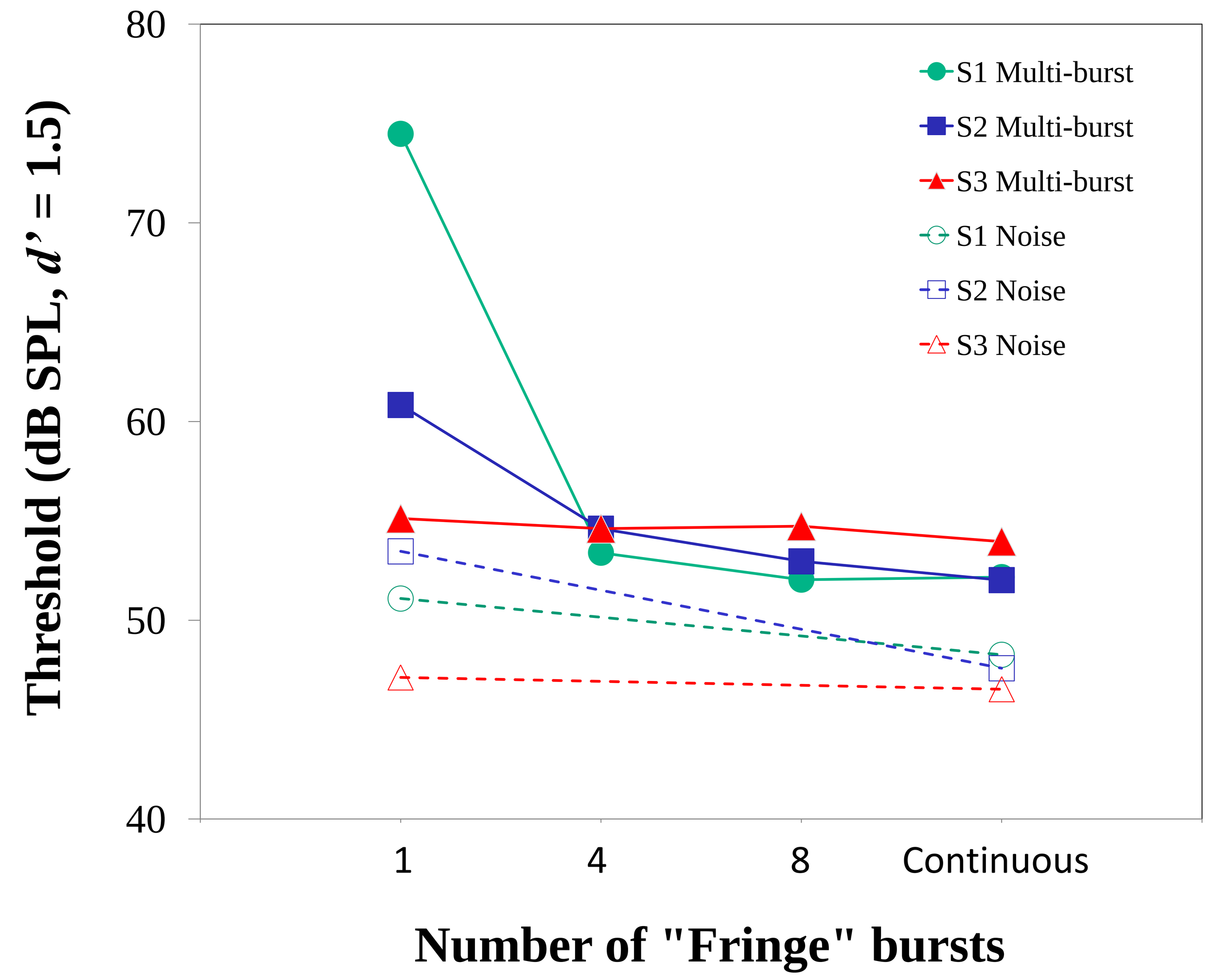

Figure 2

Discussion (cont.)

For the Multi-burst masker, it seems unlikely that energy in the signal channel provides useful information concerning the signal onset/offset. This reflects the fact that the masker does not always have energy in the signal channel – the odds there is *no energy at all* prior to or following the signal is approximately 0.2 for the maskers studied here. Comparing Pink Noise and Random Multi-burst maskers, the variability in power (dB) for maskers filtered using a 1/3 octave filter, then integrated over 60, 240, or 480 ms, is an order of magnitude larger for the Random Multi-Burst than the Pink Noise masker.

Second, for the Multi-burst masker it appears that there is no cost of signal temporal uncertainty on thresholds. This is seen in the fact that thresholds are independent of fringe vs. continuous conditions once the number of fringe bursts exceeds 4.

Summary

Consistent with past work, in this experiment providing a masker “fringe” prior to and following the signal to be detected leads to lower thresholds. The mechanism of release, however, seems unlikely to parallel those for the detection of a tone added to noise because the fringe does not provide reliable informational in the signal channel.

When segregation/streaming cues are available to subjects, as in the current experiment, there may be little if any effect of temporal uncertainty regarding the signal onset on detection thresholds.

Acknowledgements and References:

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