



Loudness Matching for Enhanced Sinusoids

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Introduction

When a target sound is masked by a notched masker, thresholds can be lower when a preview of the masker precedes the detection interval (Richards *et al.*, 2004). These experiments asked whether signals enhanced by such precursors are also louder. The method of adjustment (Experiment 2) was used in a three interval paradigm.

		L1	L2	L3	L4	AVG
Threshold (dB SPL)	a)	38.9	46.2	36.6	26.4	37.0
	b)	49.6	54.2	52.5	26.1	45.6

Table 1: Thresholds for the detection of a 1000-Hz tone added either second (top row) or third (bottom row) interval for each listener.

Results:

Consistent with past results, for three of the four listeners detection thresholds are lower when the detection interval follows a precursor associated with the masker than a precursor that includes energy at the signal frequency (Table 1).

Experiment 2:

This experiment evaluated the subjective loudness of the 1000-Hz tones in the second and third intervals. Listeners were instructed to adjust intensity of the 1000-Hz tone in the second interval (test tone) to sound equally loud as the 1000-Hz tone in the third interval (standard tone). A schematic is presented in panel c of Fig.1.

The research question is whether the enhanced signal (lower thresholds; Table 1) is also louder than its counterpart. If so, a match in loudness between the targets in the 2nd and 3rd intervals would require tones that are less intense in the 2nd than the 3rd interval.

Methods:

- Listeners 1-4 from Exp. 1
- Random maskers for each trial; same masker across intervals
- Using the method of adjustment, adjust the intensity of the tone in the second interval (test tone) to match the loudness of the tone in the third interval (standard tone)
- Four standard levels were tested; approximately 5, 10, 15, and 20 dB SL

Results:

For low-level standards (near threshold) the test tone and the standard tones are equally loud when the test tone has a lower level than the standard. As the level of the standard increases, equal loudness is achieved using approximately equal intensity standard and test tones.

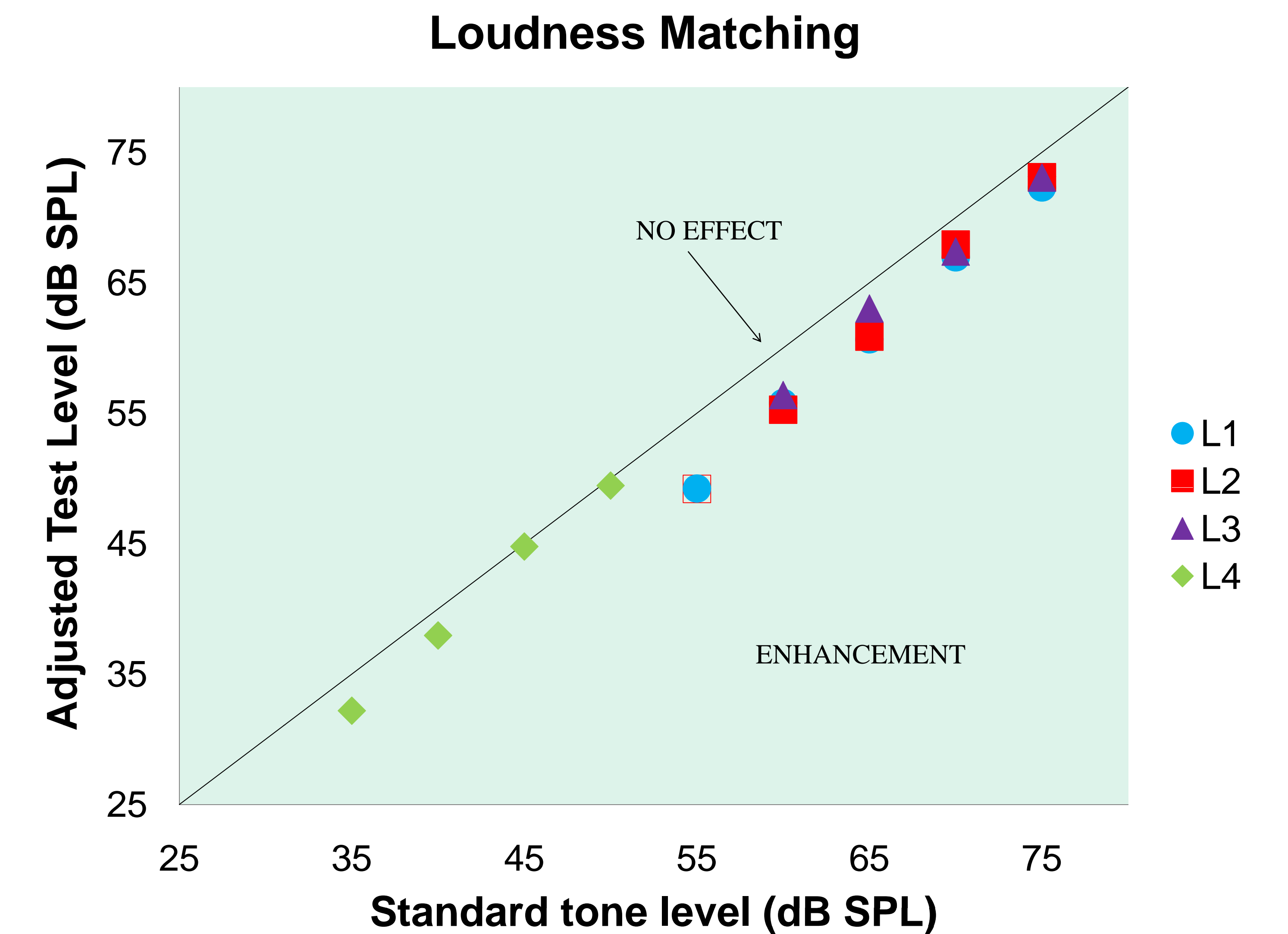


Figure 2: Test level in dB SPL set by the listeners to produce a loudness match as a function of the level of the standard tone. Close symbols indicate the standard tone level was at least 5 dB above threshold (e.g., Table 1).

Summary and Discussion

Consistent with past work, the results of Experiment 1 indicate that thresholds are lower for a masker precursor relative to a signal-plus-masker precursor (Table 1).

Experiment 2 indicates that for equal loudness, the test tone is less intense than the standard tone. However, the difference in intensity between the test and standard tones needed for equal loudness becomes smaller as the standard level increases.

These results indicate that lower thresholds associated with a masker precursor are also associated with a change in loudness of the signal tone. However, the magnitude of the change in loudness is diminished as the signal level far exceeds threshold levels.

References

Richards, V.M. Huang, R. and Kidd, G. J. (2004) "Masker-first advantage for cues in informational masking," *J. Acoust. Soc. Am.* 116, 2281-2288.

Acknowledgements:

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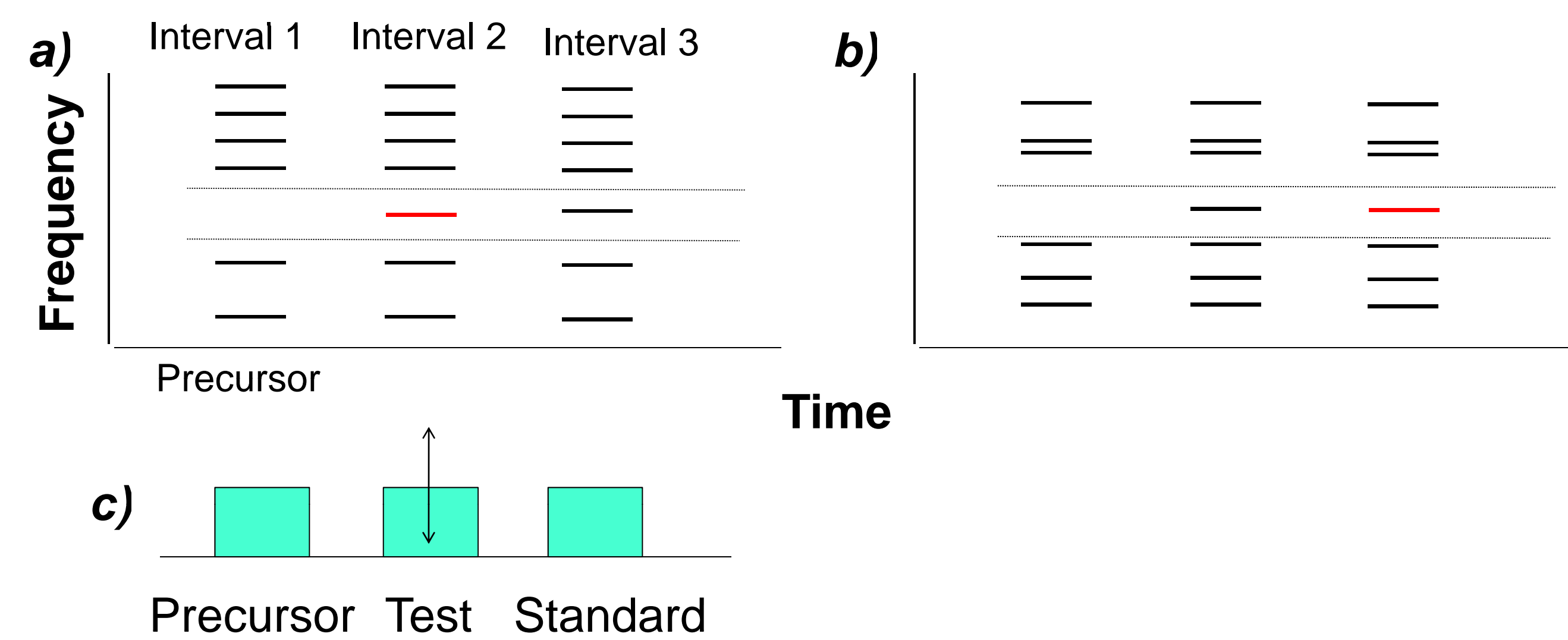


Figure 1: The top panel shows example stimuli for Experiment 1. The detection threshold for a 1000-Hz target (red) is estimated separately for the second (panel a) and third (panel b) intervals. The horizontal dotted lines encompass the frequency regions within which the masker does not occur.

The bottom panel (panel c) depicts the stimuli tested in Experiment 2. In three temporal intervals, the precursor is followed by the test stimulus and then the standard stimulus. Listeners were instructed to alter the level of the 1000-Hz tone in the test interval to match the loudness of the 1000-Hz tone in the standard interval.

Experiment 1

Detection thresholds were measured in two conditions: the signal was in the 2nd or the 3rd interval (top panels of Figure 1).

Methods:

- Four normal hearing listeners participated in a Yes/No task
- 6-component, randomly drawn masker on each trial
- Same masker on each interval
- 1000-Hz signal to be detected
- The 150-ms signal and masker are synchronous
- Time between intervals is 350 ms
- Masker components are 50 dB SPL per component