INTENSITIES DIFFERENCE IN DICHOTIC LISTENING TASKS

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INTRODUCTION

A wealth of previous studies have continuously demonstrated that when consonant-vowel (CV) nonsense syllables are simultaneously presented to normal hearing subjects in a dichotic listening task, a significant hemispheric asymmetry will be reflected from reported scores. That is when speech is used as a dichotic stimuli, a right ear advantage (REA) results. While functional hemispheric asymmetry has received supporting evidence from electrophysiological animal study as well as anatomical and physiological evidence in man, the actual size of the right ear advantage has varied from study to study.

One parameter of dichotic listening tasks which have produced inconsistent differences between right and left ear scores as well as overall performance, may be attributed to changes in the intensity presentation level. Depending on the intensity level used, a wide variance in ear score differences have been observed. A review of literature has revealed significant REA differences which range from 2.1% to 27%. Thompson and Hughes presented CV's at 6 intensity levels, 30, 40, 50, 60, 70 and 80 dB SPL to twelve adult listeners. Although a REA was obtained at all intensity levels, the magnitude of the ear advantage decreased above 50 dB SPL. Right ear advantages ranged between 4 and 13 percent depending upon the intensity level.

To date, presentation intensities have been based on absolute sound pressure levels (SPL). As an alternative to this procedure, the use of the most comfortable loudness levels (MCL) have been suggested. Recently, data have provided results which indicated that MCL is clinically feasible, statistically reliable and provides the intensity presentation level that would produce maximum speech discrimination.

To date, incorporation of MCL as a presentation level in dichotic listening studies has not been explored. Due to the variance in ear scores

derived under different levels of stimulus presentation, it was the purpose of this study to determine if the use of MCL as a presentation intensity could be demonstrated to be a viable alternative to absolute intensity levels in dichotic listening tasks.

METHOD

Subjects

A total of 30 right-handed normal hearing adult subjects was chosen for this study. Subjects met the following criteria: 1) hearing sensitivity as measured by audiometric pure-tone air conduction testing had to be 15 dB HTL or better at octave frequencies 250 to 4000 Hz (re: ANSI, 1969); 2) speech reception thresholds were at least 15 dB HTL; 3) speech discrimination scores were 90% or better as measured by recorded phonetically balanced word lists (CID-W22).

Test Stimuli

The CV syllables used in this study consisted of six English stop consonants, /b,d,g,p,t,k/ paired with the vowel /a/. Dichotic presentations consisted of independently paired syllables presented simultaneously to each ear. Each presentation was followed by a six second (± 0.5) silent period. Four individual lists, consisting of thirty dichotic pairs each, were constructed in such a way that each consonant was presented equally with no competition occurring between identical CV syllables. Stimulus duration for all CV syllables was exactly 270 ms., with a signal-to-noise ratio of plus 30 dB SPL or better. The stimulus tapes were constructed by using a special computer program at the Kresge Research Laboratory South by Dr. Charles Berlin.

Instrumentation

All the monaural and dichotic listening tasks were performed in a sound treated booth (IAC-1200). CV syllables were presented on an Akai-4000 stereo tape recorder operated at 7½ ips. The signal was fed via a Madsen OB-70 Clinical Audiometer coupled to Telephonic TDH-39 earphones with MX-41/AR cushions. The acoustic outputs of the earphones were calibrated using a Brüel and Kjaer (Type 2209) sound pressure level meter and an artificial ear (Type 4105), prior to the testing of each subject.

Procedures

Five individual test lists consisting of 30 CV nonsense syllables were used as stimuli in the present study. Intensity levels and list presentations were counter-balanced to assure the elimination of any possible order or learning effect. In addition, all subjects received 30 monaural CV syllables at MCL using equal loudness as the criterion. All responses for CV syllables were on an answer sheet provided and subjects were instructed to use a two-forced choice recall method of response.

RESULTS

Thirty normal hearing adult subjects received dichotic stimuli at five presentation intensity levels, 50,60,70,80 dB SPL and MCL based on equal loudness levels. Mean MCL values were 76.3 and 76.7 dB SPL for the right and left ears

respectively. Further analysis revealed that the bracketing method used did not produce intensity differences within subjects which exceeded 3 dB between right and left ears. Results of a *t* test indicated that differences between right and left ear presentation levels were nonsignificant.

Ear Asymmetry: Monaural

Ear asymmetry for monaural scores was determined using absolute right minus left differences for ear advantage. The scores were computed by averaging the sum obtained from the right ear scores minus the sum of the left ear scores. Mean correct raw scores were 28.9 (96.3%) for the right and 29.0 (96.6%) for the left. When raw score data were statistically analyzed, no significant ear differences were obtained for monaural CV syllables. The lack of statistical difference for monaural scores indicates the similar perception capability for each subject's auditory pathway under normal conditions.

Ear Asymmetry: Dichotic

In the present study, the percentage of error (POE) index was used as a measure of the relative degree of lateralization without variations due to accuracy, the amount of guessing, level of presentation or the method of subject response.

Based on POE scores, a two-way analysis of variance with repeated observations was performed on the results. Although the analysis of overall dichotic performance as a function of intensity proved significant differences between ears, intensity/subject interactions were nonsignificant. In essence, no intensity level was significantly different than any other within the present dichotic paradigm. Subsequent *t* scores were computed in order to analyze between-ear differences for the five individual intensity presentation levels. Results produced significant individual right ear advantages for each of the 5 presentation levels. REA's ranged between 5.9% at 80 dB SPL to 12.2% at MCL.

Mean POE scores at the 5 intensity presentation levels were obtained. The direction and degree of lateralization are represented by the POE scores contributed by the left ear. A percentage of greater than 50% indicates right ear/left hemisphere dominance.

DISCUSSION

Although the results of a two-way analysis of variance revealed nonsignificant differences between the five intensity presentation levels, individual REA differences were seen. These results are consistent with previous studies which also show a variance in the REA based on several intensity presentation levels. A maximum REA of 12.2% was obtained at MCL. The other absolute intensity levels used in the present study produced REA's which ranged from a minimum of 5.9% obtained at 80 dB SPL to 11.4% at 60 dB SPL. To date, no firm conclusions can be drawn from the range in percentage differences (6.3%). When taking into consideration, however, the degree of descussation between the two auditory pathways and the multitude of neural innervation occurring in both the primary and secondary projection centres of the auditory cortex, it is little wonder that the effects of intensity can only be speculative.

One advantage in using MCL, however, as a presentation level of choice may be the balancing of potential differences between the individual auditory pathways. According to recent research, dichotic laterality may be affected by physiological interaural differences such as loudness and the level of test presentation because of small asymmetries in the peripheral auditory system.

The utilization of MCL as an intensity level has also been found to have applicability for the study of pathological hearing impaired subjects when dichotic listening tasks were employed. Recently, Jacobson presented a series of dichotic CV syllables at equal loudness levels using MCL as the loudness criteria to a group of 30 moderate bilateral symmetrical sensorineural subjects and 10 normal hearing adults in order to determine interaural intensity differences between ears. In every case, a significant ear advantage was observed and interaural intensity differences were proven to be a nonsignificant influencing factor in ear laterality. Jacobson concluded that MCL would compensate for possible physiological loudness differences in sensorineural patients who suffer from recruitment.

CONCLUSIONS

The intent of this study was to determine the effect different intensity levels had on REA scores in a CV dichotic listening paradigm. To accomplish this task, five different intensity levels (50,60,70,80 dB SPL and MCL) were utilized in presenting a dichotic listening task to 30 normal hearing subjects. Although MCL produced the largest REA, the ANOVA data analysis revealed non-significant differences between the five presentation levels. Results of the study would suggest that the use of MCL as a presentation level in dichotic listening paradigms is a visible and acceptable procedure and may have direct applicability when investigating a population with known peripheral asymmetries.

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