

SUMMARY

Auditory training as part of an aural rehabilitation program was first introduced more than a quarter of a century ago to improve “rusty listening skills”. More contemporary auditory training techniques such as dichotic listening training used to treat CAPD have not been readily adopted for use with the hearing impaired population, partly due to limitations related to peripheral hearing loss. This paper examines the use of staggered dichotic listening training (SDLT) in 3 adult subjects with both CAPD and hearing loss. They completed a web-based program, CAPDOTS-Integrated™, based on SDLT. Results indicate significant recovery on behavioural test scores supported by self-reports of improved functioning in natural listening environments. The study suggests that SDLT is not only feasible but may also be valuable for the hearing-impaired population. Further research investigating the use of SDLT as part of an aural rehabilitation program for appropriate individuals is strongly supported.

INTRODUCTION

Technological innovations in hearing aids have made phenomenal strides in mimicking cochlear function to address the effects of peripheral hearing loss. Not as successful, however, has been the ability to address the resultant auditory processing deficits due to the peripheral hearing loss. Specifically, impaired dichotic listening has been correlated with decreased mental flexibility¹. Left ear deficits on dichotic tasks have also been found in the elderly and those with Alzheimer’s Dementia which were postulated to be due to cortical attention network insufficiencies, callosal atrophy and increased subcortical white matter lesions².

Central Auditory Processing Disorders (CAPD) has mostly evolved separately from our understanding of peripheral hearing loss and hearing aids. Aural rehabilitation and CAPD auditory training developed in parallel with much the same tenets applied to different populations – the hearing-impaired and those with normal hearing respectively. The existence of comorbid hearing loss and CAPD has been acknowledged more recently³. This has led to increased interest in applying CAPD based auditory training to the hearing-impaired population.

Contemporary CAPD auditory training paradigms like dichotic listening training for those with deficits in dichotic listening, binaural integration/separation or atypical interaural symmetries have become increasingly popular⁴. Successful use of dichotic listening training has been reported in individuals with CAPD and normal hearing abilities⁵⁻⁸, with generalized improvements into natural listening environments, academic performance and attention control⁹.

Hearing loss presents a challenge for typical dichotic listening training programs which utilize interaural loudness intensity differences – in particular if the hearing loss is asymmetrical. A staggered dichotic listening training (SDLT) approach allows for different timing onsets with balanced interaural loudness levels thereby neutralising the effects of hearing loss and possible hearing asymmetries¹⁰. There was also early speculation on the use of SDLT in the hearing-impaired population⁹. CAPDOTS-Integrated™ (C-I™) is an online CAPD therapy program that provides intervention for dichotic listening deficits using SDLT.

PURPOSE AND METHODOLOGY

This study examines the utilization of SDLT using a web-based program, C-I™ in 3 adults with co-morbid peripheral hearing loss and CAPD, specifically a dichotic listening deficit.

Prior to commencing C-I™, the subjects had been fitted with combination white noise/hearing aids as part of a Tinnitus Retraining Therapy (TRT) program. Once sound tolerance had improved significantly, the subjects commenced C-I™ from home. Average treatment time was 10 weeks and conducted 5 days a week, 30 minutes per day. Two of the 3 subjects used their hearing aids together with stereo Bluetooth streaming during their auditory training.

The subjects were reassessed following auditory training. Subjective perspectives on their own behavioural changes and personal performance in natural listening environments were also obtained.

RESULTS

Background Information

- CS, 38yr old male suffered blow to right side of his head in an industrial explosion.
- Noise-induced hearing loss, tinnitus, hyperacusis, CAPD (dichotic listening deficit), post-traumatic stress disorder, anxiety depression after accident.

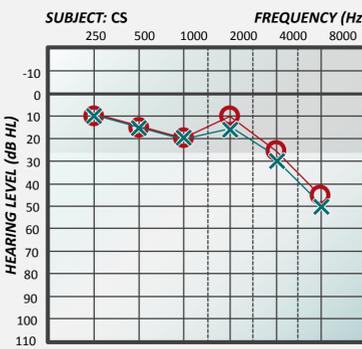


Figure 1: Audiogram CS, 38yr old male

Test	April 2014	December 2014
SCAN-3 AUDITORY FIGURE-GROUND		
Standard Score	8*	10*
95% Confidence Interval	5 - 11	7 - 13
Percentile Rank	25	50
SCAN-3 COMPETING WORDS (FR)		
Standard Score	5*	12*
95% Confidence Interval	3 - 7	9 - 15
Percentile Rank	5	75
NU-#6 FILTERED WORDS		
RGT (norm > 78%)	80%	92%
LFT (norm > 78%)	64%	78%

TABLE 1: Comparison of pre- and post- C-I™ test scores for CS showing improvements to within normal range. Training was completed without hearing aids, headphones were adjusted to (elevated) comfortable loudness levels.

- VS, 63yr old female teacher diagnosed with a concussion after she fell off a ladder at school.
- Moderate presbycusis, tinnitus and reduced sound tolerance, CAPD (dichotic deficit)
- Failed return-to-work attempt due to errors and friction with colleagues

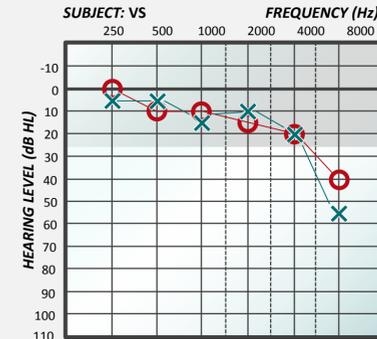


Figure 3: Audiogram VS, 63yr female teacher

Test	July 2011	October 2012
DICHOTIC DIGITS TEST		
RGT (n > 90%)	45%	92.5%
LFT (n > 90%)	70%	97.5%

Table 4: Pre- and post- C-I™ test scores for VS showing improvement to within normal range bilaterally and improved interaural symmetry. Training conducted with patient’s own hearing aids and Bluetooth streaming.

VS joked that her friends and colleagues no longer got so angry, frustrated or annoyed with her since completing C-I™. She attributed this to a decrease in misunderstanding and better self-awareness and alertness of the surrounding relationship dynamics.

Test	August 2013	January 2014
SCAN 3 FILTERED WORDS		
Standard Score	1*	11*
95% Confidence Interval	1 - 3	9 - 13
Percentile Rank	1	63
SCAN-3 AUDITORY FIGURE-GROUND		
Standard Score	1*	6*
95% Confidence Interval	1 - 3	3 - 9
Percentile Rank	1	9
SCAN-3 COMPETING WORDS		
Standard Score	1*	12*
95% Confidence Interval	1 - 3	10 - 14
Percentile Rank	1	75
SCAN-3 COMPETING SENTENCES		
Standard Score	4*	9*
95% Confidence Interval	3 - 5	8 - 10
Percentile Rank	2	37
60% WIPI		
RGT (norm > 80%)	60%	80%
LFT (norm > 80%)	48%	80%
DICHOTIC DIGITS TEST		
RGT (n > 90%)	67.5%	100%
LFT (n > 90%)	62.5%	100%

Background Information

- MB, 60yr old female Grade One teacher was involved in an MVA in which she was rear-ended.
- Moderate, presbycusis hearing loss prior to accident, CAPD (auditory closure, dichotic deficit).
- Unable to continue teaching, overwhelmed by class of 20 children

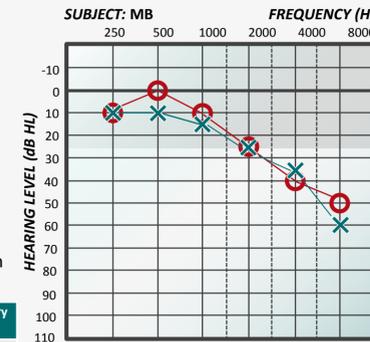


Figure 2: Audiogram MB, 60yr female teacher

Test	August 2013	January 2014
SCAN 3 FILTERED WORDS		
Standard Score	1*	11*
95% Confidence Interval	1 - 3	9 - 13
Percentile Rank	1	63
SCAN-3 AUDITORY FIGURE-GROUND		
Standard Score	1*	6*
95% Confidence Interval	1 - 3	3 - 9
Percentile Rank	1	9
SCAN-3 COMPETING WORDS		
Standard Score	1*	12*
95% Confidence Interval	1 - 3	10 - 14
Percentile Rank	1	75
SCAN-3 COMPETING SENTENCES		
Standard Score	4*	9*
95% Confidence Interval	3 - 5	8 - 10
Percentile Rank	2	37
60% WIPI		
RGT (norm > 80%)	60%	80%
LFT (norm > 80%)	48%	80%
DICHOTIC DIGITS TEST		
RGT (n > 90%)	67.5%	100%
LFT (n > 90%)	62.5%	100%

Table 2: Comparison of pre- and post- C-I™ test scores for MB showing significant improvements to within normal range except for monaural auditory figure-ground perception which lies within the borderline range. Training completed with patient’s own hearing aids using Bluetooth streaming.

MB was extremely pleased with the outcome of her treatment and reported that she felt “almost normal”, referring to her pre-accident status. She continues to be a full-time user of amplification.

CS reported that his colleagues no longer needed to “talk close to his ear” and that he was picking up conversations more quickly. CS also shared that prior to the accident, he had played weekly Scrabble with a friend for many years but since the accident, his scores had been so poor that his friend no longer wanted to continue the tradition. Since completing C-I™, CS joked that his scores had now improved back to pre-accident levels and that this weekly game had since resumed.

DISCUSSION

All 3 subjects showed significant improvements in dichotic listening abilities after completing C-I™: (1) overall test score improvements were noted on dichotic listening tasks such as the Dichotic Digits or SCAN-3 Competing Words subtest; (2) improved performance on the poorer ear resulting in decreased interaural symmetry in both dichotic tests and in monaural low-redundancy tests. Post-SDLT scores for the most part fell within the normal or borderline range for all 3 subjects.

The improvements in behavioural test scores post-SDLT suggests that the training technique may be as efficacious in the hearing-impaired population as that reported in the literature for normal hearing individuals. The results support the use of C-I™ both with and without hearing aids in mild and moderately hearing-impaired individuals with diagnosed dichotic deficits. Incorporating the subjects’ hearing aids using stereo Bluetooth streaming is instinctively useful in allowing the subject to train with the very instrumentation that they would use in their natural environment.

Post-SDLT test scores also correlated with the subjects’ own reports and improvement

rating scale. All subjects reported improved performance and where rating scales had been completed, a minimum of 3/5 was reported for all questions. Where the restitution of listening, attention and understanding skills were intuitively expected, surprising benefits related to improved communicative exchanges and smoother social relationships were made by VS, with specific reference to reduced arguments or disagreements with her colleagues.

Limited hearing aid benefit, poor hearing aid use and even rejection of amplification may result from an underlying central processing deficit in the elderly. The positive test findings provide impetus to explore the use of SDLT in those with CAPD from head injuries, Alzheimer’s Dementia and the elderly. Callosal relay, cortical attention and mental flexibility which are affected by dichotic listening weaknesses may be improved with SDLT. Such improvements could enhance hearing aid prognosis and usage, with long-term benefits as patients continue to use their hearing aids long after completing C-I™.

CONCLUSION

The study supports the use of SDLT in the form of C-I™ in adults with comorbid hearing loss and CAPD. These findings suggest that the presence of a mild or moderate peripheral hearing loss does not preclude individuals from participating in SDLT where dichotic deficits are suspected. Further research investigating the use of SDLT as part of an aural rehabilitation program for appropriate individuals is strongly supported.

DISCLOSURE: Carol Lau is the designer and owner of CAPDOTS™ (CAPD Online Therapy System) used in this study.



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